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COCKCHAFERS.

By E. A. BUTLER, B.A., B.SC.

WHILE the vast majority of British insects avoid obtruding themselves on human observation, and so are never seen except by nature-students who specially search for them, there are a few that comport themselves very differently, and hence are more or less familiar objects even to those who are least conversant with nature's mysteries. Such insects are of course common species, but their familiarity is not a necessary consequence of their abundance. There are many species equally, if not more, abundant, which yet are absolutely unknown to any but the professed entomologist. These well-known species attain their notoriety partly, it may be, from their size, but chiefly because they do not shun the busy haunts of men; and even in their own native woods and fields, instead of keeping under cover, they are inclined to roam, and so often encounter pedestrians. These remarks apply very forcibly to the subject of the present paper. From early childhood, all country residents must be familiar with cockchafers, and even the townsman may know something of them, provided only that bricks and mortar have not absolutely banished nature's greenery from his neighbourhood. The blind and blundering, headlong, whirring flight of the cockchafer, its proneness to enter at open windows, and cling to bedroom drapery, the pertinacity of grip it manifests when once it has alighted on curtains, dresses, or even it may be, on ladies' hair—these are all familiar experiences in the summer months. The insect, so apt thus to make itself a nuisance to the public generally, as well as a plague to agriculturists, has many interesting features and is well worth a close and detailed study.

Let us look at it first in its adult condition. A bulky, and solid-looking creature, chestnut-coloured above and black beneath, about an inch in length, with a pointed, downward bent tail, six powerful legs ending in strong hooked claws, and a pair of substantial membranous wings stowed away under two horny coverings, the whole insect dusted over with what looks like a mealy powder—such in brief is the Common Cockchafer or May Bug (*Melolontha vulgaris*) (Fig. 1). From the structure just

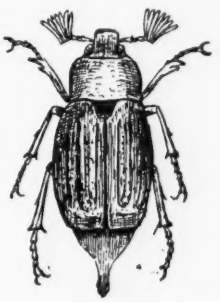

FIG. 1.—Male Cockchafer.

outlined we gather that the insect belongs to the order Coleoptera, or beetles. The mealy powder with which it is covered pretty easily rubs off, so that after knocking about for a while in the world the cockchafer begins to look threadbare and frayed, and shows its chestnut ground colour more distinctly.

The apparent mealy powder shows under the microscope as little white scale-like hairs lying side by side and pointing backwards. They are more thickly strewn in some parts than in others, and the females have a particularly dense covering of them. On the breast they are replaced by a shaggy covering of long yellowish hairs. All along each side of the abdomen, just below the edges of the wing-covers, is a row of snow-white triangular patches made of similar and still broader scales, each patch being sharply outlined and bounded by the general black surface—a striking colour scheme which vastly improves the appearance of the insect and redeems it from absolute plainness. This covering of scales and hairs makes the cockchafer an instructive insect for illustrating the gradual change of an organ of given elemental shape into one altogether different. A careful examination under the microscope will show that even the broadest of the scales are merely expanded hairs, and from different parts of the body a selection might easily be made of all varieties of these appendages ranging from the narrowest (Fig. 2), which would unhesitatingly be called hairs, through a series of minute modifications whose exact name would be doubtful, to what again would be unhesitatingly described as scales.

The last segment of the abdomen tapers away to a point which is differently shaped in the two sexes, that of the female being much the blunter of the two. This pointed tail proved in former days an irresistible temptation to the mischievous youth of England, who

used to run through it a bent pin attached to a thread some eight or nine feet long. The end of the thread being held in the boy's hand, the cockchafer was tossed into the air, when of course it spread its wings and tried to fly away, but was kept like a captive balloon, struggling at the end of the string. This was the well-known and very ancient pastime of cockchafer-spinning.

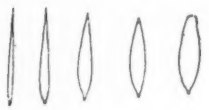

FIG. 2.—Scales of Cockchafer.

FIG. 3.—Antenna of Male Cockchafer.

The sport seems to have been known even to the Greeks some 2400 years ago, but the Greek boys contented themselves with tying the string to the insect's leg instead of running it through the tail. To judge from an illuminated illustration contained in a 14th century MS., the British youth practised a similar sport with butterflies.

The wings, which are folded away most daintily under their brown covers, are of stout membrane, much strengthened along the outer border to give them the firmness of stroke necessary for raising into and maintaining in the air so bulky a body. These wings are about twice as long as their covers, and consequently have to be folded crosswise in the middle before they can be stowed away. They are the sole organs of flight, and the buzzing sound they produce has given the insects the name of "chafers," though this name is not confined to the present species, but is technically applied to the whole tribe of which it is a representative. This tribe is not numerously represented in Britain, but in tropical regions there are an immense number of species, which include some of the largest and some of the handsomest beetles in the world. The prefix "cock," which distinguishes the present species, is considered by Dr. Murray to imply strength or valour, or to have reference to the practice of making the insects fight, so that it would be equivalent to the "strong or valiant buzzer."

Unquestionably the most beautiful part in the structure of a cockchafer is the antennæ. These, again, differ in the sexes, those of the male being the more graceful and elegant. Each consists of ten joints, of which the basal one carries a brush of hairs, and the last seven are extremely short, each furnished in the male with a long leaf-like flap on its inner surface. The flaps lie close together when the animal is at rest, but when it is on the alert, they are opened out like the leaves of a book, so as to give a beautiful fan-like appearance (Fig. 3). The opening of these leaves seems to imply an attitude of attention, so that it corresponds to the pricking up of the ears on the part of a vertebrate. In the female the basal leaf is missing, the corresponding joint being furnished only with a short spine, so that there are but six leaves, and they are both narrower and shorter. Each leaf is closely covered on both surfaces with little pits or depressions, from the centre of which springs a minute hair. From their structure one can hardly doubt that they are highly sensitive organs, though it may not be easy to say what is the precise signification of their curious shape. That they are larger and handsomer in the male suggests the possibility of their having something to do with sexual selection. That they are not, however, purely ornamental follows from their sensitiveness and from the fact that the insects are quiescent in daylight, when personal attractions might count, and active towards dusk, when they could not easily be perceived.

I have spoken above of the tenacity of grip these insects manifest, and when the structure of the feet is examined, there can be no surprise that they are so difficult to dislodge. At the end of each foot are two strong hooked claws, each with a couple of teeth at the base beneath, and with the terminal portion of the claw delicately grooved (Fig. 4), all of which peculiarities help to make them effective clinging organs. In this part of her structure the female insect has the advantage, as the basal teeth are considerably larger and more powerful in that sex than in the male.

Having thus given my readers suggestions as to those parts of the cockchafer's external anatomy which are most worthy of examination, I must pass on to consider the insect in the earlier stages of its career, and to sketch its life-history. Unlike the majority of insects, it is gifted with considerable longevity, living, in one or other of its forms, through four distinct summer seasons. The eggs are laid in May, and as the larva is subterranean in its habits, the female lays her eggs underground, selecting a site for the purpose where the soil is loose and dry. She descends about six or eight inches below the surface and lays a batch of from thirty to thirty-five eggs, and she may spend some two or three days in the operation, remaining buried all the time. A few days afterwards she again works her way down through the soil and lays another batch in a different place. Three times in succession will this, as a rule, be done, and the more vigorous insects will even lay four batches of eggs. The number diminishes somewhat in the successive batches, but we may say that each vigorous female cockchafer may become the parent of from sixty to eighty young, a rate of multiplication which easily explains the enormous numbers of the insects which are sometimes met with. A little calculation will show that if a female lays on the average sixty eggs, and if no more than one-third of these on the average produce females, yet in about twenty years, the descendants then alive of the female cockchafer would amount to upwards of 180 millions, supposing that no

FIG 4.—Claws of Cockchafer.
a. Male. *b*. Female.

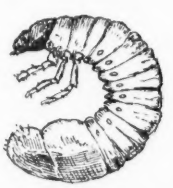

FIG. 5.—Larva of Cockchafer.

accidents have happened. That the insects do not appreciably increase in numbers therefore shows how extensive the chapter of accidents must be. The mothers seem to suffer from a disease which sometimes brings about the putrefaction of the eggs before they are laid, while the armies of rooks, jackdaws and other birds make persistent and successful warfare upon the larvæ.

About six weeks after the laying, the eggs, which are at first oval, but afterwards become almost spherical, hatch, producing little fat whitish grubs, each with six legs close behind the head, and a pair of good biting jaws on their disproportionately large heads. Their food

consists of the roots of plants, and during the latter part of one summer, the whole of a second, and the first part of a third, they spend their time in nibbling these roots, whereby they of course either seriously weaken or altogether destroy the plants attacked. The amount of damage, therefore, that one of these grubs can do during its two years' course and more, is very considerable, and as the work of devastation is all carried on beneath the surface of the ground and thus out of sight, its prevention is correspondingly difficult. Man, in fact, must rely largely upon workers whose senses are more acute than his own if these grubs are to be detected in their clandestine work. And here it is that the rooks and jackdaws aforesaid come in useful, their acute sense of hearing enabling them to detect the movements of the grubs as they work their way through the soil, and of their jaws as they enjoy their subterranean repast. In winter the grubs go deeper into the ground, where they will be out of the reach of sudden changes of temperature.

In the third year of its existence, the grub is full-grown (Fig. 5) and about an inch and a half long, with a shiny chestnut-coloured head, and three pairs of legs similarly coloured. The hinder part of the body is always bent round in a semi-circle towards the head, and is very much swollen, the dark-coloured contents of the intestines showing plainly through the thin skin. When the grubs are quite young, the damage they do is inconsiderable, and is confined to the tenderer and more delicate root fibres, but during their second and third years they are exceedingly voracious and devour an enormous amount of food, not neglecting even the coarser root fibres which had before been too much for their jaws. There is probably a certain small balance of agricultural benefit to be set over against the damage they commit, because their tunnelling movements serve to loosen the soil, and while they are devouring their proper food, they necessarily swallow a good deal of earth and so perform services analogous to those rendered by earthworms.

In the July of its third summer, the grub goes down to a depth of about two feet and there excavates an oval cell, which it lines with a gummy secretion. Here, throwing off its last larval skin, it changes into a chrysalis, which, like those of beetles generally, shows plainly all the parts of the future insect—legs, wings and antennæ, bent round to its under surface and tightly enclosed in a thin skin. The chrysalis stage is a very brief one, lasting only for about a month. Then another and final moult takes place, and the insect appears a full-grown and perfectly formed, though soft-skinned, cockchafer. By the end of August, then, or at latest, the beginning of September, it has completed its cycle of changes, but it is by no means ready for the active business of adult life. In fact, it remains in its cell underground shut up for the winter, and destined to lie helplessly there in company with its last two cast skins till the genial days of spring summon it to the surface. By about the 20th of April, close upon three years after its mother laid the egg from which it was hatched, its skin has suitably hardened, and it performs its first feat in tunnelling as a perfect insect by making a shaft, up which it travels to the open air and the sight of the country around, which it thus beholds for the first time in its existence.

Once above ground, the cockchafer climbs up into trees, having a particular liking for oak, beech, chestnut, poplar, and elm, upon the young leaves of which it now begins to feed. It has still some seven or eight weeks to live, and that time, which will be a busy one, has to be spent in providing for the coming generation. Frequent pairings take place, and the intervals between the courtships or egg-layings are spent in feasting, both the sexes recuperating their energies by devouring great quantities of the leaves of the before-mentioned trees, or failing them, of whatever else can be found. Thus the insect, in its early stages a devourer of roots, becomes, when fully grown, addicted to leaves and green herbage generally, a curious change of diet which suggested to an old writer the following quaint reflections:—"This seems one of the wise Contrivances of Nature, that adapts as most proper the Airy finer nourishment for the more agile and light Body of the Volatile Insect, while the same Animal, when a dull Reptile Worm, is sustained by a more gross and terrene Food, more fitting to its slow and heavy Nature." Both the sexes are excellent diggers, and the male frequently goes beneath the surface as well as his partner, though for what purpose it is not easy to say. The powerful spurs on the fore-legs, which are always found in digging insects, are no doubt useful in excavating the burrows. Though most abundant about May or June, the insects may be found more or less frequently all through the summer, the males being met with, at least in this country, much more commonly than the females. The insect has now come to the end of its career; by the time autumn is over they have disappeared, and it seems that none are left to hibernate.

The unusual length of the larval life produces a periodicity in the appearance of the adults which has some remarkable features. For example, the adult cockchafers which were to be found during the now closed season of 1901, were not the descendants of any that might have been seen in the preceding year, but sprang from those which appeared in 1898. These latter laid their eggs in the early summer of 1898, and the grubs lived underground during the years 1898, 1899, and 1900, becoming pupæ in July, 1900, and perfect insects in August of the same year, but not appearing above the surface till April, 1901. It appears, therefore, that the swarms of cockchafers should be seen every third year, and this, at least on the Continent, is certainly the case. But the remarkable fact is that the year is not the same one in all parts. For example, Switzerland may be mapped out into three distinct regions, in which the cockchafer year falls on different dates. Thus in the region near Basle, the cockchafer year occurs when the date of the year divides by three without a remainder; in the Berne district when it divides by three with a remainder of one, and in the Uri district when the remainder is two. Thus 1899 was a cockchafer year at Basle, 1900 at Berne, and 1901 at Lucerne. Thus it follows that three generations of cockchafer grubs are at the present moment living in the soil in different places, destined in their turn to yield the adult insects of the years 1902, 1903, and 1904.

We have said that the males are more frequently seen than their partners, and this is particularly the case in the pairing season, when large assemblages of males may be noticed in the evening circling like a swarm of bees round the tops of trees or over the gable-ends of houses. When the insects are plentiful, they often lose their foothold in the trees in the daytime and drop to the ground, when they are eagerly sought after by swine and poultry. In the year 1688, enormous swarms appeared in the west of Ireland, and the pigs seem to have flourished upon them.

Besides the common cockchafer, another insect, of

XUM

somewhat similar appearance, but smaller, much more hairy, and without the white scales and triangular patches, is also met with in this country, though perhaps not quite so commonly. It is sometimes called the July Bug (*Rhizotrogus solstitialis*), and has habits similar to those of *Melolontha*. Another insect, nearly allied to these, and much handsomer, is that known as *Phyllopertha horticola*. It goes by a variety of local and popular names, such as bracken clock, fernweb, fernshaw beetle. It is considerably smaller than either of the others, hairy, and with a metallic green thorax and reddish wing covers. It sometimes does considerable damage to gardens, as well as to pasture land. It is often found in strawberry beds, and is particularly common in the eastern counties. Canon Fowler says that this beetle is a good bait for trout, chub, and other freshwater fish. The common cockchafer, as being an easily procurable insect, has been often used as a typical instance of insect structure; its anatomy was very fully worked out by Strauss-Dürckheim, and it has been used for experiments in insect locomotion.

ANIMAL PERFUMES AND THEIR ORIGIN.

By R. LYDEKKER.

ALTHOUGH fashionable enough in former days, the three chief perfumes of animal origin, namely, civet, ambergris, and musk, have steadily declined in popular favour in their unmixed condition, and are now chiefly employed to form a basis for other scents of a less powerful nature. All three are products of mammals, and all appear to have been known from very ancient times indeed, although much misconception was long prevalent with regard to the real origin and nature of the second.

Nowadays naturalists are almost universally in the habit of calling the animals from which the first-named of the three is obtained "civets," although in popular language they are termed "civet-cats." Apparently there is little doubt that the latter usage is correct, the name civet being properly applicable to the perfume itself rather than to the animal by which it is secreted. In a well known dictionary we find, for instance, the following:—

"CIVET, *n.* [Fr. *civette*; Ar. and Per. *zabad.*] The sweet scent of any beast; a semi-fluid substance taken from under the tail of the civet-cat and used as a perfume. *vt.* To scent with *civet*; to perfume."

"CIVET-CAT, *n.* The animal that produces civet."

Again, in Shakespeare and other early writers the word civet is invariably employed to designate the perfume itself.

Of civet-cats, to give them their full title, there are several distinct species, the typical representative of the group (*Viverra civetta*) being African, while the others are inhabitants of India and the Malay countries. These animals, the largest of which is about the size of a cat, while the smallest may be compared with a pine-marten in size, are near relatives of the genet and the palm-civets, and more distant cousins of the mongooses. Their affinities with the cat tribe are comparatively remote, although, in spite of their long and pointed muzzles, they are much more closely related to those animals than they are to the dogs. They are coarse-haired, flat-sided creatures with small ears, partially retractile claws, a long tapering tail, and generally a crest of long hairs running down the middle of the nape and back. The ground-colour of the fur is greyish, upon which are streaks or blotches of black or blackish brown, the tail being ringed with black. The most striking and characteristic feature of their coloration is, perhaps, the black gorget on the throat. The civet, which is a white fatty substance, is contained in two small pouches, or infoldings of the skin, situated beneath the base of the tail.

To obtain the civet the animals are kept in confinement enclosed in long cages so narrow that they cannot turn round. Two or three times a week the back of the cage is opened, and the animal dragged by its tail close up to a cross-bar, when the civet is carefully scraped out of the pouches by means of a wooden spoon or spatula. When collected the perfume is carefully enclosed in an air-tight vessel. The amount of civet yielded depends, it is said, to some extent upon the food on which the animal is fed. If the civet be not periodically removed, some of it is discharged by the animal itself; and the walls of the cages of the civet-cats in the Zoological Gardens are frequently smeared with this odoriferous substance, which is carefully collected by the keepers.

A very large amount of commercial civet is yielded by the large African civet-cat, already mentioned, but the large Indian species, or zibeth (*Viverra zibetha*), which derives its name from a corruption of the Arabic and Persian designation of the perfume, is probably equally prolific in this respect. The smaller oriental civets, the smallest of which—the rasse—has been introduced into Madagascar, yield, of course, a less amount of this valuable substance.

Formerly, at any rate, civet-cats were kept in Holland for the sake of their perfume, as is attested by the following extract from Hutton's translation of Buffon's Natural History, published in 1823:—

"In Holland, where no small emolument is derived from their perfume, they are frequently reared. The perfume of Amsterdam is esteemed preferable to that which is brought from the Levant, or the Indies, which is generally less genuine. That which is imported from Guinea would be the best of any, were it not that the negroes, as well as the Indians, and the people of the Levant, adulterate it with mixtures of laudanum, storax, and other balsamic and odorous drugs."

Roughly speaking, about twenty thousand ounces of civet are annually imported into London; of pure Jeddah civet the value is eight shillings and sixpence per ounce, of "commercial" civet seven shillings.

Very different to civet, both in character and in origin, is the substance known as ambergris. The name of this very remarkable substance is of French origin, *ambre-gris*, signifying grey amber, or rather perhaps grey perfume, the word amber itself (Fr. *ambre*) referring to the odoriferous qualities of the substance it designates, as is exemplified by the verb *ambre*, to perfume.

Ambergris is generally found floating on the surface of the sea, and very different ideas have been entertained as to its nature and origin. It appears, however, that so early as the middle of the sixteenth century it was known to have some connection with whales; although the nature of this connection was not fully realised. One writer, for instance, in describing a sperm-whale stranded on the Norfolk coast, expresses his surprise at not finding ambergris in its stomach. Although the idea that ambergris is swallowed by the sperm-whale is erroneous, the writer in question was quite correct in regarding that substance as pertaining to this particular species of cetacean.

A century later the original idea of the association of ambergris with whales seems, however, to have been abandoned in favour of a notion that it was the gum of a tree. On the other hand, in an early edition of

Johnson's Dictionary (1818) it is described as being either floating honeycomb or guano.

Buffon, however, was fully convinced of its cetacean origin; and in the translation of his work already cited we find the following passage in connection with the sperm-whale:—

"As to the ambergrise which is sometimes found in this whale, it was long considered as a substance found floating on the surface of the sea; but time, that reveals the secrets of the mercenary, has discovered that it chiefly belongs to this animal. . . . It is found in a bag of three or four feet long, in round lumps, from one to twenty pounds in weight, floating in a fluid rather thinner than oil, and of a yellowish colour. There are never seen more than four at a time in one of these bags; and that which weighed twenty pounds, and which was the largest ever seen, was found single. These balls of ambergrise are not found in all fishes of this kind, but chiefly in the oldest and strongest."

While there is much of truth in this account, there is a certain amount of error. As a matter of fact, ambergris is usually found floating at sea, or more generally cast up by the waves on the shore. The fact that it contains the horny beaks of squids and cuttles belonging to species that form the food of the gigantic sperm-whale, or cachalot (by far the largest of the cetaceans furnished with teeth), is alone sufficient to indicate that it is a product of that monster. And from time to time it is actually found in the alimentary canal of that whale. It appears, indeed, to be a biliary concretion, closely analogous in its nature to bezoar stones, and due to the existence of disease in the individuals in which it occurs. In place, therefore, of being found only in old and strong specimens, it is generally at least met with rather in those in poor condition or which have died a natural death. The bags containing ambergris mentioned in Buffon's account would appear to be portions of the whale's intestines which have been cut out and tied up with their contents.

When first taken from the sperm-whale's interior ambergris is a soft greasy substance, exhaling an exceedingly disagreeable odour; and it is only after exposure to the air that it hardens and acquires its characteristic aroma, which is described as being sweet and earthy. As its name implies, ambergris is of a grey colour.

The largest piece of ambergris known to Buffon, as above stated, weighed twenty pounds, but masses largely exceeding this have since been recorded. A piece weighing one hundred and thirty pounds, the value of which was fully five hundred pounds, is, for instance, definitely known, while according to Messrs. Van Beneden and Gervais a mass weighing no less than nine hundred and eighty-two pounds is stated to have been at one time in the possession of the Dutch East India Company. According to information kindly supplied by Messrs. Piesse and Lubin, the average amount of ambergris imported yearly into this country may be put down roughly at one thousand pounds. In a recent trade circular the value of "fine grey" is given as one hundred and twenty-five shillings per ounce, and of "fine black" seventy shillings.

Formerly ambergris found a place in the pharmacopœia, but its sole use at the present day is in perfumery, mainly as a base for other scents of a more delicate nature.

The third substance on our list—musk—is the product of the male musk-deer, or kastura (*Moschus moschiferus*), of the Himalaya and Central Asia, a hornless ruminant of about the size of a small goat. In many respects, such as the possession of a gall-bladder to the liver, this animal approximates to the hollow-horned ruminants, although it is generally regarded as an aberrant member of the deer family. In addition to a rough coat of very coarse and almost pith-like hair common to both sexes, the musk-deer is specially characterised by the presence of a pair of long scimetar-like tusks in the upper jaw of the male, as well as by a peculiar pouch situated in the groin of the same sex yielding the perfume from which it derives its name.

Although by some writers the name *Moschus* has been derived from μόσχος, the Greek for a calf, it really appears to have a totally different origin. For instance, in the dictionary from which one quotation has been already made in an earlier part of the present article, we find the following item:—

"MUSK, *n.* [L., *muscus*; Pers., *mashk*; Ar., *musk*; Hind., *mushk*, *misk*; late Gr., *moschos*, the same as *oschos*, a bag.] A strong-scented substance obtained from a *cyst* or *bag* near the navel of an animal that inhabits the mountains of Central Asia; also, the animal itself. *vt. To perfume with musk.*"

From this it appears that the word musk originally means the bag in which the natural substance is contained. The origin of the name kastura (the first *a* pronounced as the *u* in musk) is less easy to ascertain, but it appears evidently connected with castoreum, the aromatic product of the beaver.

The musk bag, or "pod," is cut out from the animal after death, and when full contains about an ounce of musk. At the time when the rupee was worth two shillings or over, the value of a musk-pod in the Indian bazaars was about one pound sterling. The amount of musk in a pod varies according to season, and the age of the animal; apparently the pods are full only during the pairing-season. When properly taken, the odour of musk is so strong as to cause headache in those by whom it is inhaled. And so enduring is the scent that a piece of musk may be preserved in a room for years, and at the end of that period will be almost as odoriferous as at first.

Messrs. Piesse and Lubin estimate the annual import of musk into England roughly at ten thousand ounces. Several descriptions and qualities are recognised in the trade, as may be seen from the accompanying extract from a recent commercial circular, where the wholesale prices are quoted:—

"Tonquin Pile	I.	...	...	per oz.,	75/- to 80/-
„	„ III.	...	...	„	32/6 to 50/-
„	grain	...	...	„	90/-
„	„ pure	...	...	„	110/-
„	„ coml.	...	...	„	65/-
Assam	„	...	...	„	60/-
Cabardine	„	...	...	„	45/-
Nepal	„	...	...	„	40/- "

In addition to being employed largely in perfumery, musk is also used in the confectionery trade.

Of less importance than either of the preceding in the perfumery trade is *castor*, or *castoreum*, the secretion of the beaver, of which, according to information kindly furnished by the well known firm of perfumers above mentioned, about one thousand pounds are annually imported into England, at a value of about twenty shillings per pound. Although the use of this scent in perfumery is limited, it is very largely employed in the preparation of Russia leather, to which it communicates the well-known odour.

From accounts dating as far back as the year 500 B.C., it appears that beavers were originally hunted for the sake of their castoreum alone, the felting properties of their fur not being discovered till centuries later.

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The castoreum is contained in a couple of pouches situated in the groin of the beaver, which when extracted and dried are not unlike two pears; about six pouches going to the pound. In olden times castoreum was regarded as an almost universal panacea, and its value was proportionately high. Although this substance no longer appears in the pharmacopœia, in America, according to the author of *Castorologia*, "the belief in the miraculous properties of the castoreum is still shared by so many, that the crude article is even now regularly sold in our drug stores, and its value steadily increases so that quotations of from eight to ten dollars per pound are current for the rough Canadian 'castors' as the pouches are sometimes called, while the Russian article is even more valuable."

It may be added, as a somewhat remarkable circumstance, that the castoreum of the American and Old World beavers differs remarkably in chemical composition, the former containing 58.6 per cent. of resin and 2.6 per cent. of calcium carbonate, while in the latter we find only 13.8 per cent. of the resin and as much as 33.6 per cent. of the carbonate. The reason for this extraordinary difference is not easy to suggest.

Two other perfumes of animal origin, namely, "musquash" and "musk-rat" are recognised in the trade, but, according to information communicated by Messrs. Piesse and Lubin, are at the present day of no commercial value, the former being too rank, and the latter too faint. It is a little difficult to trace the origin of these two perfumes, since the "musquash" and "musk-rat" are one and the same animal—*Fiber zibethicus*, a North American relative of the water-vole. Possibly the two kinds of perfume may be taken at different seasons, or may be the product of different sexes.

Yet another substance of animal origin, held in great estimation in the east, both as an antidote to poison and as a remedy against all kinds of disease, may be appropriately noticed in this place. This is the celebrated bezoar, which is commonly believed in Persia to be obtainable only from the wild goats (*Capra hircus ægagrus*) inhabiting the hills between Karman and Shiraz, although it doubtless occurs in those of other districts, and probably also in other species of wild goats or ibex. The name bezoar, according to the late Sir O. B. St. John, is Persian, and should properly be *pa-zahr*, a corruption of *fa-zahr*, which means "useful (for) poison." Bezoar stones are concretions formed in the stomach of certain individuals of the wild goat, and vary considerably in size, shape, and colour. A specimen described in Blanford's "Zoology and Geology of Eastern Persia" was egg-shaped, and measured three-quarters of an inch in length; its colour being dark olive and the surface highly polished. In Persia bezoars are greatly valued, and in addition to being used as a medicine and as an antidote to poison, are sometimes worn by the women as amulets or charms, encased in gold filigree work.

SPECTRUM OF LIGHTNING.

PHOTOGRAPHS of the spectrum of lightning were obtained on July 18 and 21, 1901, by Mr. J. H. Freese, under the direction of Mr. Edward S. King. The 8-inch Draper Telescope was used with an objective prism. The telescope was directed to the portion of the sky in which the lightning was particularly bright, and when the observer thought that he had obtained an image, the plate was changed. Even then many of the plates were badly fogged. A number of photographs were taken in this way, and showed the curious fact that the spectrum of lightning is not always the same. One flash, on July 18, showed three bright bands, while another taken on the same evening showed ten bright lines, and closely resembled one taken on July 21. The latter is shown in Figure 1. To increase the contrast

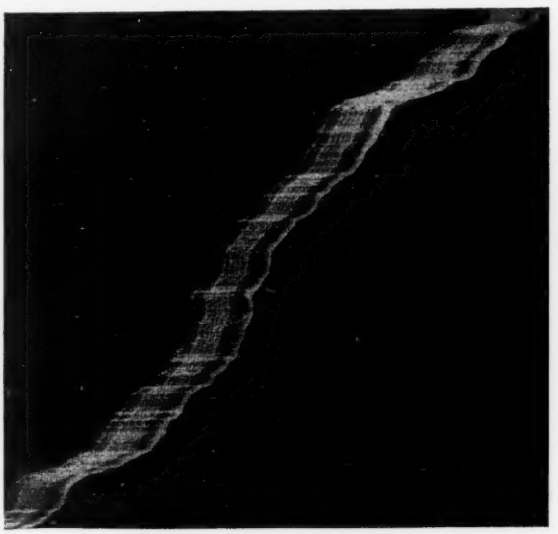

FIGURE 1.

of the original negative a double contact print was made from it with slow plates, and is reproduced in the figure on the original scale. The brighter portion of a second flash, clearly seen in the original negative, also appears in the print. Measures, each consisting of three settings, were made of three portions of the principal spectrum, and the means of the results are given in Table I. The original negative was an isochromatic plate. The successive columns give the hydrogen lines with which certain of the lines are assumed to be identical, the mean wave length and intensity of the lines in the spectrum of lightning, and the wave length and intensity of the principal lines in the spectrum of Nova Persei, No. 2, on March 23, 1901.

TABLE I.

SPECTRA OF LIGHTNING AND NOVA PERSEI.

Hyd.	W. L.	Int.	W. L.	Int.	Hyd.	W. L.	Int.	W. L.	Int.
Hγ	.....	...	3836	4	Hγ	4341	5	4341	10
Hζ	3881	10	3889	5		4441	?	4468	4
Hε	3956	2	3970	7		4519	1	4573	3
	3998	3				4643	8	4646	6
	4046	2	4030	2		4754	1	.....	...
Hδ	4102	8	4102	8	Hβ	4861	5	4862	10
	4147	4	4149	1		4940	?	4925	1
	4187	?	.....	...		5022	2	5015	3
	4222	5	R	2		5173	1	5171	3
	4263	1	.....	...		5595	30	R	20

The first line in the spectrum of lightning is a broad, bright band, extending from wave length 3830 to 3930, and is perhaps identical with the nebular line 3875.

The line 4222 appears as a broad band in the Nova. The last band is very broad or perhaps a continuous spectrum extending in both objects from about wave length 5300 to 6000. The lines in the two spectra appear to resemble each other closely both in position and in intensity. On September 15, 1901, a photograph was obtained with the 11-inch Draper Telescope, showing nearly thirty bright lines. Some of these show a curious doubling, the separation varying in different portions of the flash. Apparently, this is due to another flash, in whose spectrum only a portion of the lines appear.

EDWARD C. PICKERING.

November 16, 1901.

CONSTELLATION STUDIES.

By E. WALTER MAUNDER, F.R.A.S.

XII.—THE GREAT HUNTER AND HIS DOGS.

THE long nights of winter are the time when the heavenly hosts gather in their most resplendent squadrons. Sirius, by far the brightest of all the fixed stars, reaches the meridian at midnight of New Year's Day. Orion, the most splendid single constellation, is crossing from 10.30 to 11.10, the same night. Procyon, the Lesser Dog star, follows Sirius in its southing by about forty minutes. East and west of these are the two bright zodiacal constellations of the Twins and the Bull. South and east of Sirius is the hugest of the constellations, the ship Argo, resplendent with many brilliant stars, but distinguished amongst all the stellar groups by the numbers and the compact clustering of the small stars just clearly within the grasp of the unaided sight. Aratus marks the special glory of this region, though Dr. Lamb fails, as he too often does, to represent his exact meaning.

"First rise athwart the Bull—majestic sight,
Orion's giant limbs and shoulders bright,
Who but admires him stalking through the sky,
With diamond-studded belt and glittering thigh.
Nor with less ardour, pressing on his back,
The mottled Hound pursues his fiery track.
Dark are his lower parts as wintry night,
His head with burning star, intensely bright,
Men call him Sirius, for his blasting breath,
Dries mortals up in pestilence and death."

Both the Authorised and the Revised Versions of the Bible refer the Kesil of Job xxxviii., 31, to this constellation. There is much probability that the rendering of the Revised Version for the other two constellation names mentioned in this text, Aish and Kimah, "the Bear" and "Pleiades," are quite correct, but there is more uncertainty in the present identification. Kesil means "impious, mad, rebellious," and as such is traditionally supposed to refer to Nimrod, "the mighty hunter before the Lord," supposed to be the first great conqueror, and the first to set up a tyranny based upon military power. One difficulty in rendering Kesil by Orion is that the same word occurs in the plural in Isaiah xiii., 10, where the word is translated "constellations." If Kesil, therefore, really refers to Orion we must suppose that in this passage the most glorious constellation of the sky is put for constellations in general. The context, however, would rather lead to the idea that we should look for a winter constellation to correspond to Kesil; for just as "the sweet influences of the Pleiades" evidently refer to the revival of nature in the spring, so "the bands of Orion" may be naturally supposed to point to its imprisonment by the cold of winter. If Nimrod be really the original Orion, there was an unsuspected appropriateness in the sycophantish proposal of the University of Leipsig to give the centre stars of the group the name of Napoleon, the most modern example of the same mad ambition.

Brown traces the name Orion to the Akkadian Ur-ana, "the light of Heaven," a poetical and most natural title for the most beautiful and brightest of all the stellar groups. And it may well have been that, as Brown further thinks, this name was given because the constellation was taken as a stellar reduplication of the one great light of heaven, the sun, or the same name having been given independently to both the sun and the constellation, the latter was taken as representing the former. The stellar giant, therefore, on this view presents to us a personification of the sun, "rejoicing as a giant to run his race."

But what does he pursue? His prey is found in the little constellation beneath his feet, one of no distinction or brilliancy, the Hare.

"Up from the east the Hare before him flies,
Close he pursues her through the southern skies."

Now it is certain, as Brown points out, that "the amount of folklore and zoological myth which all over the world connects the moon and the hare is simply astonishing." Of course it does not necessarily follow that the Hare as a constellation is also a symbol of the moon, but at least the suggestion has no improbability. It is possible, therefore, that in Orion the mighty hunter trampling on the timid fleeting hare, we ought to recognise a primeval emblem of the rising sun overpowering and crushing with his vastly more powerful light the feebler rays of the moon as she flees before him towards the west. But whether the two Dogs which we find attending and following Orion have any deeper meaning than the natural desire to piece out this picture of a hunter and his chase, by providing him with a leash of hounds, may well be doubted.

The figure of the giant hunter is one of the very easiest to make out of all the constellation figures. Seven bright stars stand out with special distinctness. That furthest to the north-east of the seven is obviously orange in colour, and is Alpha, Betelgeuse, "the shoulder of the giant." The star in the north-western corner is Gamma, Bellatrix, "the female warrior." This last title is from the translation in the Alphonsine Tables of the Arabic title Al Najid, "the conqueror." The south-western corner is held by Beta, Rigel, the "foot," the brightest star of the constellation. The fourth corner, the south-eastern, belongs to Kappa, now known as Saiph, "the sword," the name having been transferred to this star from Iota, to which it really belongs. Three stars mark the Belt of the giant, as the four foregoing mark his two shoulders and his legs. These in succession are, Delta, Mintaka, "the girdle"; Epsilon, Al Nilam, "the string of pearls"; and Zeta, Al Nitak, "the belt." The sword is marked by a short row of stars in a straight line below Epsilon. These are, 42, Theta and Iota. Theta, to the eye, is a misty star; its diffused appearance being due to the great nebula, the most glorious object in the heavens. Between Alpha and Gamma, but a little to the north, is a compact little triangle of stars, Lambda and Phi 1 and Phi 2, which mark Orion's head. His club stretches up across the Milky Way to the feet of Gemini and the horns of Taurus, whilst between Bellatrix and Aldebaran a curving line of stars runs nearly due south, marking the lion's mane, which the Hunter is shaking before the eyes of the Bull, as if it was the scarlet cloak of a toreador.

The little constellation of the Hare does not contain much of interest for the naked-eye observer. Its principal star, Alpha, sometimes known as Arneb, "the

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hare," is very near the point of an equilateral triangle, of which Beta and Kappa Orionis form the base.

A far more majestic triangle, and more nearly exact in its proportions, is that formed by Betelgeuse, Sirius and Procyon.

"Let Procyon join with Betelgeuse and pass a line afar,
To reach the point where Sirius glows, the most conspicuous star;
Then will the eye delighted view a figure fine and vast;
Its span is equilateral, triangular its cast.

The constellation of Canis Major, though in itself a brilliant one, lies so low for English observers that practically we think of little but its chief star. But this is so far and away the brightest in the sky, being more than two full magnitudes brighter than the average first magnitude star, such as Aldebaran or Altair, and is rendered so unusually striking by the intensity of its scintillations, that it serves alone to amply distinguish the constellation to which it belongs. Its excessive scintillation is due to two causes; the one that in these latitudes it can never attain any great elevation; the other, its striking bluish-white colour. For stars of that colour scintillate more markedly than those of any other, and Sirius being the very type and model of the class, its flashing renders it as conspicuous as its brightness.

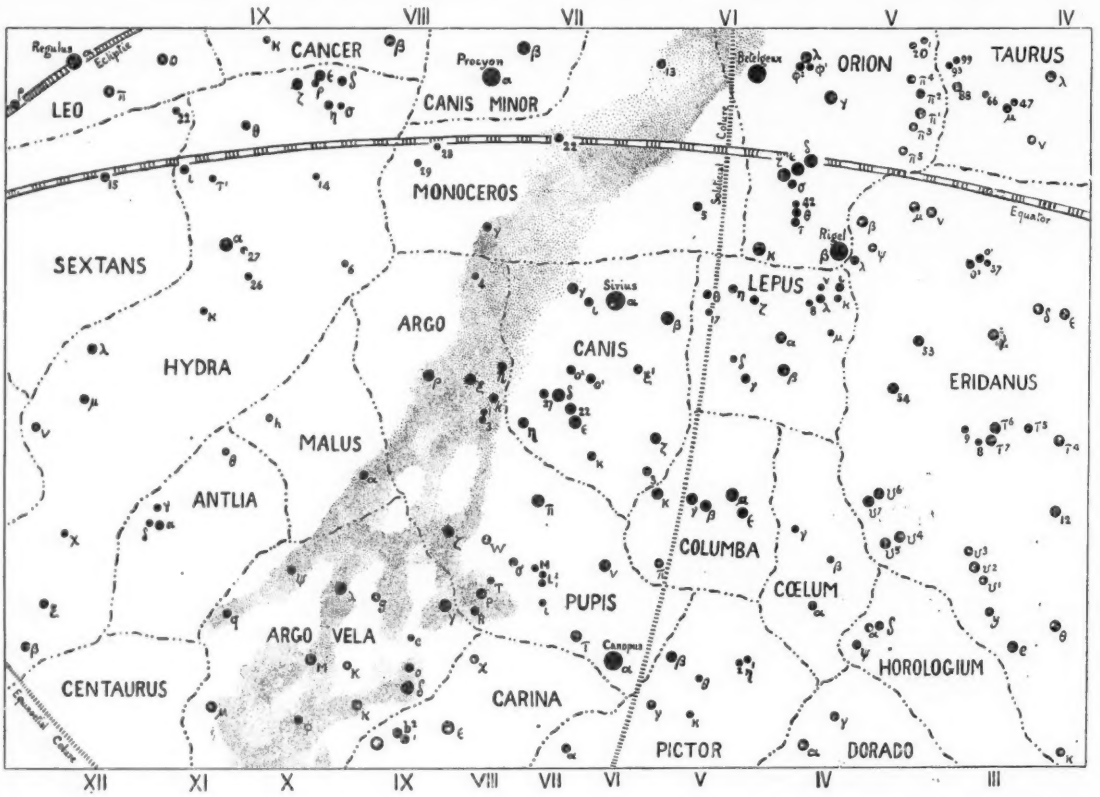
"The fiery Sirius alters hue,
And bickers into red and emerald."

The name Sirius is usually taken as bearing its Greek meaning of "sparkling," "burning," or "scorching," an appropriate enough name for the brightest of the stars and one in conjunction with the sun at the beginning of summer. Other renderings interpret it as "chief," or "prince," or "the bright and shining one"; all equally natural and appropriate for this prince of stars. Our name for the Lesser Dog, Procyon, is simple enough. It is merely "before the dog"; in other words, Procyon was the forerunner of Sirius, not as crossing the meridian earlier, but as rising before it and so heralding its appearance.

The colours of the four brightest stars of this region are very well worth studying; the orange of Betelgeuse being in strong contrast with the steel-blue of Rigel and Sirius, whilst Procyon, though a white star, yet shows a distinct creamy or yellowish tinge, which to a sensitive eye is on a fine night very clearly distinguishable from the colder hue of the two brilliants first named.

The constellation of the Lesser Dog in Ptolemy's Catalogue numbers only one star in addition to Procyon. This is Beta, Gameisa, the "dim-eyed," possibly as meaning that Procyon is so much less brilliant than Sirius. Or it may be that it is a corruption of Al Gamus, the "puppy." A glance at the sky shows that Procyon and Gameisa stand at much the same distance apart as Castor and Pollux, and the Arabian astronomers used to call the space between the two stars of the Twins "the long cubit," whilst that between the two of the Lesser Dog was "the short cubit,"—an old instance of the tendency, which seems so irresistible, to account a space in the heavens of some seven to ten degrees of arc in length as equivalent to a terrestrial yard.

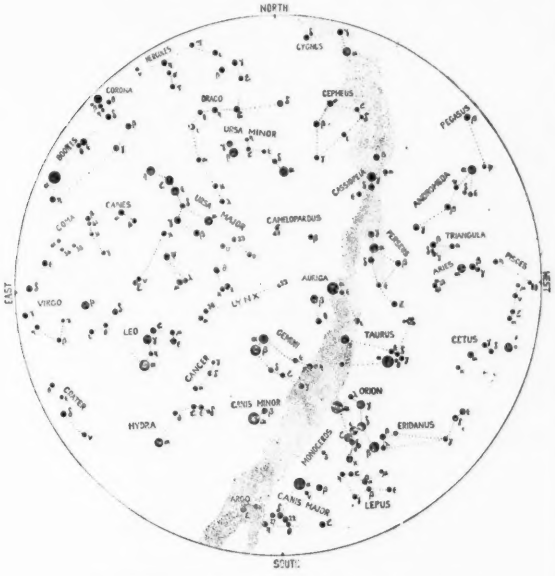
Procyon and its companion form yet another proof that the constellation names were not given in consequence of forms suggested by the actual groupings of



Star Map No. 12; The Great Hunter and his Dogs.

the stars. Certainly there is nothing to suggest a dog in the presence of two fairly bright stars some five degrees apart.

The Greater Dog is a far fuller constellation. Beta precedes Sirius some twenty-two minutes and is therefore called Murzim, the "Announcer." Quite low down near our horizon is a right-angled triangle of bright stars, the right angle being marked by Delta. Epsilon and Eta at the two other points of the triangle lie some three degrees further south and are nearly on the same



The Midnight Sky for London, 1902, January.

parallel with each other; Epsilon is Adhara, the "back." Delta is in the centre of a very interesting region, a curious curve of small stars preceding it, whilst another follows.

Argo is scarcely at all an English constellation, the greater part of its huge bulk lying below our horizon. The vessel is drawn in our atlases and described by Aratus as travelling stern foremost. Thus in Brown's translation we read:—

> "Stern forward Argo by the Great Dog's tail
> Is drawn; for her's is not a usual course,
> But backward turned she comes, as vessels do
> When sailors have transposed the crooked stern
> On entering harbour; all the ship reverse,
> And gliding backward on the beach it grounds.
> Stern forward thus is Jason's Argo drawn."

The Greek legend of the voyage of the Argonauts under Jason to recover the Golden Fleece was believed by Sir Isaac Newton to have an actual historical basis, and to record the beginning of Greek commerce. In fact in his view the constellations generally were designed by the Greeks to celebrate the heroes and deeds of this great expedition. The knowledge which later times have brought us have compelled us to recognise that the constellations are far older than Newton thought them, and beyond a doubt Proctor was quite correct in recognising in Argo and the southern constellations near it,—Centaurus, who is represented as having apparently just left the ship and the Altar at which he is sacrificing,—a pictorial record of that great Deluge of which the Hebrew and the Babylonian accounts agree so strikingly. The Altar lies entirely below our English horizon; the Wolf, the somewhat inappropriate animal whom the Centaur is offering up, shows but two or three faint stars; and Theta Centauri, the star in the Centaur's head, is the only bright member of that constellation visible to us.

THE PROGRESSIVE SPECTRUM OF NOVA PERSEI BETWEEN FEBRUARY 22 AND NOVEMBER 28, 1901.

By Rev. WALTER SIDGREAVES, S.J., F.R.A.S.

THE new star is already old while its birth and rapid growth are fresh in our memories. Its brightness, its colour, and its spectrum have been watched with assiduous care throughout its short life, and a large collection of spectrographic plates preserve the record of surprising changes in the structure of its light beams, for the study of the future. The question now is, what has been learned so far from this apparition in Perseus?

Can it be, in miniature, the life-history of a fixed star, of unnumbered ages enacted in the brief span of a few months? Not, certainly, in relation to its birth and growth; but in its decline the Nova might have been expected to exhibit the stages of a star cooling. The loss of heat, whether in ages or in months, should pass through the same degrees of temperature; and the successive spectra of Nova Persei between February 22-23, when the star was at its greatest splendour, and September 5, when it had fallen to near the seventh magnitude, should have become the guiding signs for the classification of stars on the descending scale of temperature. But the changes have been too rapid; the process of ages has been rushed through in hours rather than in months; and no one knows what has been hidden from us in the day-light hours and by the evening clouds of February 24.

On February 22 the spectrum of the star was found, at Harvard College in America, to be of the Orion type, with the first glimmer of bright radiation at the red side edges of the hydrogen lines. On February 23, at the same observatory, a faint photograph "showed no marked change, except that the line K was present."* On the same date at Edinburgh the visual spectrum was described as "a distinct but feebly developed solar type"; † and on the Potsdam plates the 9 hydrogen lines, from Hβ to Hκ appeared as "broad absorption bands, very weak, diffuse, and only recognisable with difficulty."‡

On February 24 a great change in the spectrum was found on the photographs at Harvard College, and at the Yerkes Observatory. "It was traversed by numerous bright and dark bands, and closely resembled that of Nova Aurigae."§

Thus in the short space of 48 hours the star's spectrum had changed from that of a white star of the Orion type to a composite spectrum of bright and dark lines: a change to be worked out on a fixed star in ages of time! The intermediate changes are not so

* Ap. J., XIII., 172.
† Edinburgh Circular, No. 54.
‡ Vogel, Ap. J., 218.
§ Pickering, Ap. J., XIII., 172.

clearly known as could be wished; but they are not entirely lost. On the Harvard photographs of the 22nd the bright lines were beginning to appear; but on the Potsdam plates of the 23rd "there was not any suggestion of emission lines or bands,"‖ but the hydrogen lines were broad, weak, and diffusive. From this it would appear that on the night of the 23rd the dark hydrogen lines were widened out together with the bright lines, partly masking one another, and extinguishing the bright edges seen on the Harvard College plates of the 22nd. The two series were not yet separated, and the separation took place between the nights of the 23rd and 24th. And if this separation of the bright and dark hydrogen lines is to be attributed to velocities on Doppler's principle, and according to Lord Kelvin's explanation of the high velocity of the cooler gases after impact,¶ the actual collision of the two masses must have occurred between these two nights. Such an occurrence is not inconsistent with the previous short history of the star. It was increasing in brightness from the early morning of February 22, civil time, up to the night of the 23rd, and may have reached its maximum on the 24th in the day-light hours of both Europe and America. During the two or three days of approaching one another, both bodies would suffer tidal disturbances enough to account for the increasing white heat, and brilliant continuous spectrum. And after the crash, the temperature would rise suddenly, vaporising the masses and converting much of the continuous spectrum into gaseous radiations, with corresponding fall off in general brilliancy.

But, to return to the first enquiry, the evidence of the photographic plates of the 22nd and 23rd appears to be against any transition of the spectrum through the changes which are supposed to mark epochs in the long history of the declining life of a permanent star. The transition from the type of the Orion stars to the composite bright and dark broad line spectrum was abrupt; the bright lines had already begun to appear on the 22nd, and the dark lines were broad on the 23rd. It should, therefore, be considered possible that a star of the Orion type might die out without passing through the gradations of the Solar type, unless the gap in the succession of spectra of the Nova was covered by the leap of temperature at the impact of two stars, already suggested. After the first flash of brilliancy the hotter gaseous radiation would be less luminous than that of the previous solid or liquid state, and the scattered fragments would cool down rapidly by freer radiation into space. The pair of stars would be broken up to begin again their slow career of condensation.

The new composite spectrum of February 24, which may be called the second spectrum, to distinguish it from later forms, remained substantially the same until March 19, and is illustrated by the first four photographs of the plate. But one very significant change was in progress during this time, and was completed between March 21 and 22: the dark hydrogen lines were thinning away, and were seen for the last time on March 21. The importance of this lies in its connection with Lord Kelvin's explanation of the *approaching* velocity of the *absorbing* hydrogen. This temporary atmosphere might be very dense at first, forming broad absorption lines, and would thin away in its flight from the star, showing thinner lines and finally vanishing. So that if the dark hydrogen lines had not thinned and disappeared comparatively soon, the chief support of the impact hypothesis would have broken down.

On March 19 another great change was found in the spectrum photographed at Harvard College. This is the third spectrum of the star. It was photographed again at Stonyhurst on the 22nd, 25th, and 28th, and also at the Yerkes Observatory on the 22nd and 28th. But it was not a permanent change. The second spectrum returned on the 21st, 26th, and 27th; and up to April 26 the spectrum alternated between the two forms. The later, or third spectrum, is illustrated on the plate already referred to in the photographs of March 25 and 28. Its leading features are (1) a great apparent extension of the first ultra violet hydrogen line, Hζ, on the side of shorter wave lengths, occupying nearly the whole interval between Hζ and Hη; (2) the greater prominence of the blue bands, together with new formations between Hβ and Hγ; and (3) the loss of light in the continuous spectrum.

At first these alternations appeared to be connected with the phases of the star's light curve, which at this time were quite periodic, the minimum recurring on the 19th, 22nd, 25th, and 28th. But this three-day period failed early in April; and since then, a comparison of all the photographs taken at Stonyhurst, up to April 26, with the magnitudes of the star as measured at the Radcliffe Observatory, Oxford, has shown that the connection was not with any phase of the light variations, but with an absolute magnitude of the star. All the spectra of the third form appeared when the magnitude of the star was below 4.57; all the returns of the second spectrum occurred when the star was brighter; and on April 9, when the magnitude was at this critical figure, the spectrum had been already noted as belonging partly to both forms.**

The inference here is that at this period, when the star was largely a glowing gaseous mass, the temperature was oscillating with oscillations of the gaseous volume. This volume of mixed heated gases might well have been put into a state of great oscillation on being set free at the impact of two stars, expanding and contracting, chilling and heating; and when the mean temperature had fallen to the combining temperature of the constituents of the new band adjoining Hζ, this band would reappear and disappear with the oscillations synchronously with the light variations.

So far, therefore, there does not appear to be any insuperable obstacle in the way of the direct collision hypothesis. And the recent astonishing information from America regarding the surroundings of Nova Persei seems to demand the greatest imaginable catastrophe, and there is none greater than the clash of two cold worlds. In these surroundings there is telescopic evidence of matter drifting at a rate which leaves the alarming velocities revealed by the spectroscope to be reckoned amongst comparatively easy going speeds. And the evidence seems to be complete, in the agreement of four separate condensations of nebulosity. The positions of these on a photographic plate exposed on November 7 at the Lick Observatory, compared with a photograph at the Yerkes Observatory on September 20, show practically the same displacements of each, amounting

‖ Vogel, *ibid.* ¶ Observatory, No. 306, June, p. 223.

** These comparisons are confirmed by those of Harvard College, in Ap. J., 1901, July, with one exception, viz., that "on April 12 and 13 the magnitude was the same while the spectrum was different." But the Oxford measures give different magnitudes for the two nights, viz., 4.67 on the 12th, when the third spectrum was photographed, and 4.49 on the 13th.—M. N., May, 468.

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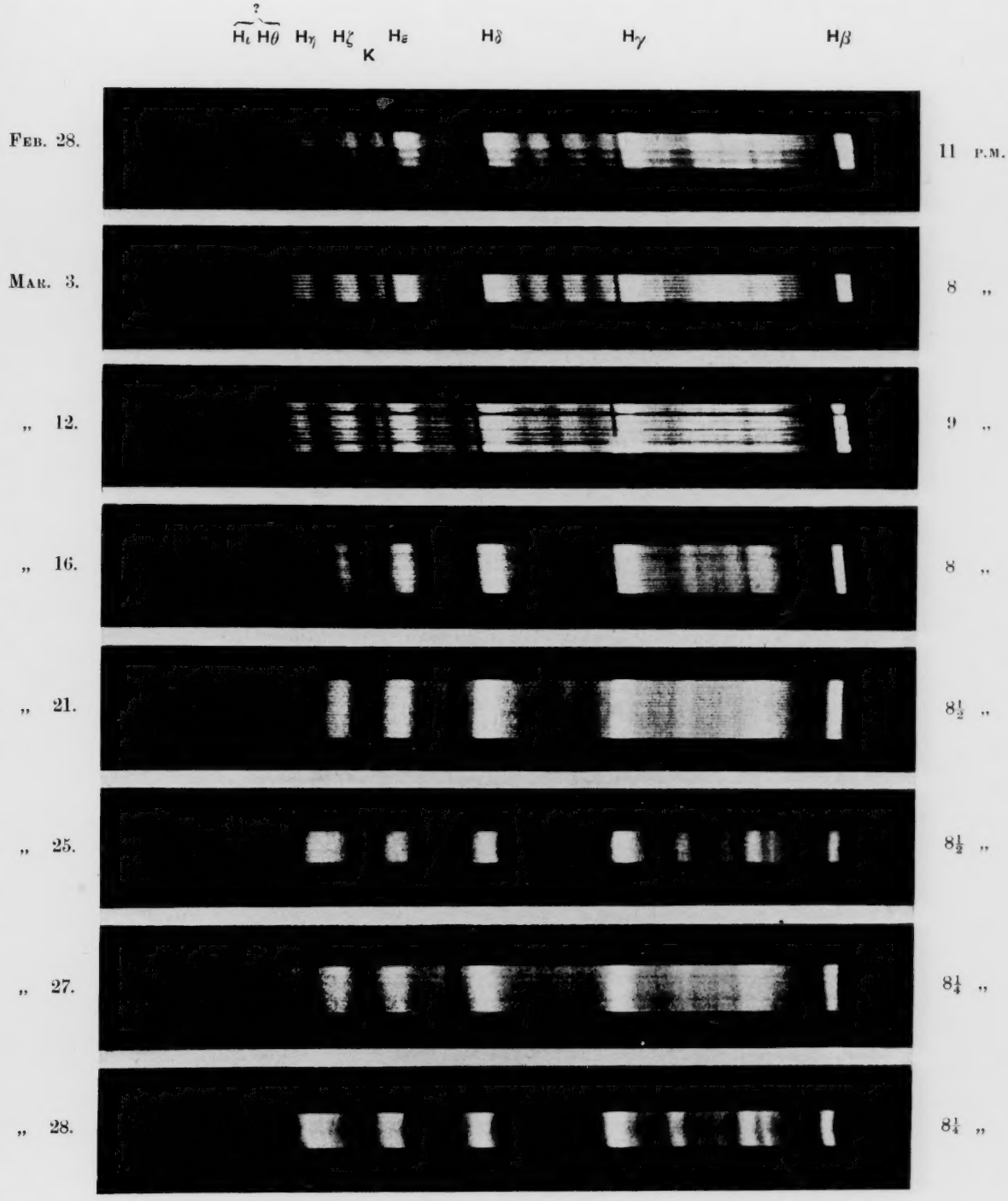
PHOTOGRAPHS OF THE SPECTRUM OF NOVA PERSEI, 1901.



Stonyhurst College Observatory.

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to $1\frac{1}{3}'$ in seven weeks, or 11′ annual proper motion††; and this at a distance no greater than that of the nearest fixed star means a velocity of 2690 miles in the second.

But difficulties begin with the persisting width of the bright hydrogen lines. Unlike their dark companions, these remained strong and broad to the end of April, and again from August 24 to November 28 they were, still, as broad as they were in the middle of April, but no longer the strong lines of the spectrum. For nine full months they have remained abnormally broad; and, since April 16, they have retained constant widths, as compact bands without their hazy edges.

A line may be widened by pressure of the radiating gas, or by the two-way displacements effected by rotating velocities about an axis at right angles to our sight-line. It is not easy to conceive the physical conditions of a star, in which the whirling velocities of the heated hydrogen atmosphere could be maintained practically constant for nine months. Pressure, on the other hand, only requires the central mass to be great enough; but the greatness is too great to be easily accepted; and the compact appearance of the lines is not an expected result of pressure, which hardly admits of uniform density with sharp edges. The difficulty is great; but it does not threaten one more than another hypothesis concerning the origin of the new star in Perseus. It seems rather to be a sign of new discoveries in the spectrum of hydrogen to be expected before any safe conclusion can be drawn about the physical condition of the star; and other peculiarities of the fourth spectrum point the same way.

The fourth spectrum was not photographed at Stonyhurst until August 24.

All the lines of this spectrum agree, in positions, with those observed in gaseous nebulæ. But they are all too broad, and four of them, 3869, 3969, 4363, and 4719, are composite bands, the first three of four components, and the fourth of three.

But apart from the question of the nebulous character of the star, the peculiarities of this spectrum are to us at present an enigma, of which the key-word is probably the line 3969. This line began to put on its present disguise at a rather later stage of cooling than its companion line 3869, at a temperature corresponding with the magnitude 5.3, by appearing in greater strength than the hydrogen line Hδ on April 16. If it is the hydrogen line Hε, what condition of glowing hydrogen is indicated by this line being now stronger than all the rest taken together, when usually it is the weakest of those present in the photographs? It might be the calcium line known as Fraunhofer's H in the Solar spectrum; and if so, under what conditions can the calcium H glow strongly without its inseparable and stronger companion K? It might be the helium line 3965 greatly widened towards the red side. Three helium lines could then be counted in the spectrum 3868, 3965, and 4713, the two latter similarly widened so much to the red side as to show the apparent centres of the bands at 3969 and 4719; and all three are composite bands. But why are these the selected lines, or why are the stronger ones absent?

The answers to these queries, when found, will define securely the physical condition of the star, at a time when its spectrum looks so like and yet so unlike that of a gaseous nebula.

†† Lick Obs. Bulletin, No. 10.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

NOVA PERSEI.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—The interesting note by M. Antoniadi on the photographic image of Nova Persei is quite in accord with exposures I have made with a portrait lens by Ross. I find the second aureola, which is shown when the exposure has lasted $3\frac{1}{2}$ hours, seems to be about $2\frac{1}{2}$ times further off the central dot than the first aureola, the latter being well shown with an exposure of only ten minutes. If a part of the object-glass is covered the portion of the image on the same side of the disc is missing. This effect can also be seen in other stars, especially those whose photographic image is larger than would be expected from their visual brightness, like δ Persei. If, now, the plate is withdrawn outside the main focus, say, for about $\frac{1}{64}$ in., the images of most stars will be nearly doubled in size, and will have a central dot surrounded by a penumbra equally darkened to the outer edge, but the image of the *Nova* will be nearly of the same size as at the principal focus of the lens, and will be made up of a central dot with a ring round it and the space between only lightly discoloured. This effect is more visible perhaps when part of the aperture is covered, when the central dot and part of the ring do not appear connected. The plate being so far behind the focal plane it will be seen that the part of the image obliterated by partly covering the object-glass is the opposite side, not the same one as in the chief focus. It seems as if there should be two bands in the spectrum beyond the part which causes the central dot, the second one being two or three times further off and of a weaker photographic effect. The spectra shown at the last meeting of the R. A. S., if I remember right, consisted of the nebulous bands and two bright thick lines high up in the violet, of which the second or further one was the brightest, and, moreover, both bands were nearer together than to the main part of the spectrum, which does not seem to correspond to the size of image obtained with a portrait lens.

Inglefield, Little Heath, Potters Bar. HENRY ELLIS.
24th November, 1901.

RAINBOW BEFORE SUNRISE.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—On the morning of Thursday, 21st November, I noticed gorgeous colouring in the south-east part of the heavens, preparatory to sunrise. Near the horizon the sky was comparatively clear, but higher up was a large patch of cloud, tinted brilliantly with red and orange, the intervening spaces being blue with shades of green. There was at the same time a shower of rain advancing from the west, which caught the bright light reflected from the cloud, with the result that a purple rainbow became visible. The time of sunrise for this day is 7.29, and the rainbow was visible from 7.15 (or possibly sooner) to 7.30, when it began to fade away; before 8 o'clock rain was falling overhead. The bow was of very large dimensions, with its two extremities at right angles to the horizon. I should be very much interested to know whether any of your readers have a record of a similar rainbow before sunrise.

E. W. JOHNSON.

50, Birdhurst Road, South Croydon,
30th November, 1901.

XUM

Notices of Books.

"ANIMAL LIFE: A FIRST BOOK ON ZOOLOGY." By David Starr Jordan, PH.D., LL.D., and Vernon L. Kellog, M.S. (Henry Kimpton.) 1901. Pp. ix. and 328. 7s. 6d. net.—This is an exceedingly interesting volume, covering the whole field of bionomics, or, as the authors prefer to call it, "animal ecology." They "have tried to put into simple form the principal facts and approved hypotheses upon which the modern conceptions of animal life are based." Although superficial in character, as may be gathered from its size, the work is nevertheless very successful. Darwinian rather than Lamarckian principles are inculcated, though no direct attention is drawn to the tenets of either school of thought, and this, remembering the nature of the work, is as it should be.

The illustrations, 180 in all, are exceptionally good and well produced. At the end of the book a classification of animals is given, which is undoubtedly useful, but most certainly marred by all disregard for order and method in the arrangement of the examples selected to represent each class. Genera and species from numerous orders are jumbled hopelessly together in one chaotic muddle, thus in Class VI., Mammalia, we have the following:—". . . . Monotremes, monkey, gopher, elk, bison, prairie-dog, big-horn, hare . . . ." and so on. Surely this chapter needs revision!

"OBSERVATION WITHOUT INSTRUMENTS: Hints for Young Watchers of the Heavens." By Arthur Mee, F.R.A.S. (Cardiff: Lennox Brothers.) 1901. Threepence.—Mr. Mee is already well known for his "Observational Astronomy," a marvel of cheapness, and of useful information, well and clearly put, and we feel sure that the reputation he so justly gained by his larger book will secure a very wide circulation for this admirable little tract. It is just the book that thousands of people need, who would like to do something in astronomy and yet cannot afford the money which good instruments, even small ones, cost. Such will find Mr. Mee's neat little pamphlet an introduction to an unsuspected pleasure.

"THE GROWTH OF OUR EMPIRE: A HANDBOOK TO THE HISTORY OF GREATER BRITAIN." By Arthur W. Jose. (John Murray.) 6s.—Accepting the author's own designation of his work as a "Handbook" to the History of Greater Britain, we can commend this volume as a thoroughly readable narrative of the great achievements of the Anglo-Saxon race in every part of the world. And if we regret the inability of a careful and animated writer to distinguish between the partisan and the historian, especially in regard to events passing before his own eyes, it is consolatory to remember that he errs in good company, and that writers of fiction have seldom equalled and never surpassed the prolific imagination of some historians. But some of Mr. Jose's speculations are very thin, and his conclusions, shall we say, deplorable. The history of this great subject has yet to be written, and we may hope that Mr. Jose's Handbook may serve the eminently useful purpose of pointing the way to the greater task. The present book contains many maps well illustrating its subject, and is furnished with a good index.

"PLEASURES OF THE TELESCOPE." An illustrated guide for amateur astronomers, and a popular description of the chief wonders of the heavens for general readers. By Garrett P. Serviss. (Hirschfeld Brothers.) Illustrated. 6s. net.—The title is singularly appropriate. It has evidently been a great pleasure to Mr. Serviss to write the description of all that can be seen, or found out, in the wonder-world that a 5-inch telescope reveals; it is certainly a very great pleasure to read it. We may say that it actually raises a feeling of envy of those who have the opportunity of examining these objects in Mr. Serviss's telescope under his personal direction. The first chapter is not the least interesting, dealing with the selection and testing of a glass. Briefly, Mr. Serviss advises the purchaser to put all his money in the glass, to have the mounting solid, however rough it may be, to carry the telescope tube indoors when not in use (a 5-inch telescope tube and glass would certainly tend to develop one's muscles), and leave "observatory, dome, draughts and all" to those who "are both fond of and able to procure luxuries." Having got the glass, he gives most practical and practicable advice as to how to learn whether any defect in the star image is due to the eye, the eyepiece, the object-glass, or its collimation. Most of the succeeding chapters tell of the double stars, variables, clusters, and nebulæ, which a 3, 4, or 5-inch telescope may be able to show in the constellations. He then describes scenes on the planets, the moon and the sun, and his final chapter discusses the question as to whether there are planets among the stars. This is evidently a matter in which Mr. Serviss takes a deep interest, and from some chance remarks scattered through the book, one learns that he considers that ours is the best possible planet, situated in the best possible solar system, and that he has a deep sympathy for any inhabitant of any planet that revolves round the sun, either interior or exterior to the earth; and very much more sympathy still for the unhappy denizens of the planets which may owe allegiance to Sirius, or to Arcturus or to any other sun.

"MICROMETRICAL OBSERVATIONS OF THE DOUBLE STARS DISCOVERED AT PULKOWA, MADE WITH THE 36-INCH AND 12-INCH REFRACTORS OF THE LICK OBSERVATORY." By W. J. Hussey. (Publications of the Lick Observatory.)—The 15-inch refractor by Merz and Mahler was the largest in the world when it was installed in 1839 in the newly erected Pulkowa Observatory. The director of the observatory, Dr. W. Struve, formulated a programme of work with the meridian circle which should give a catalogue of all stars down to the 7th magnitude between the north pole and 15 degrees south latitude. To learn their approximate places, the 15-inch refractor was used for a survey, and in the course of this a large number of double stars were marked. These doubles, in the beginning of 1898, Mr. Hussey decided to remeasure and discuss, and the present volume is the result. It is issued in the same form, as nearly as possible, as the volume of 1290 stars measured and discovered by Mr. Burnham in Vol. I. of the Yerkes' publications. Besides the measurement and discussion of these stars, which should prove of the greatest value to double star observers, Mr. Hussey reviews in the introduction the history of accidental and systematic personal errors, from the time that Dr. William Struve first suggested their existence, and his son, Otto Struve, tried to evaluate them by artificial means.

"ANNUAL REPORT ON THE STATE OF THE PARIS OBSERVATORY FOR 1900." By M. Loewy.—M. Loewy reports that this year he has begun to publish the "Photographic Catalogue of the Heavens," having issued 11 sheets containing the rectilinear co-ordinates of 16,500 stars. The Photographic Chart has not progressed so satisfactorily; its edition being paralysed by the bankruptcy of one of the two firms which undertake the heliogravure of the plates. The photographic atlas of the moon has been proceeding very satisfactorily under the direction of M. Loewy and M. Puiseux, and at the Paris Exhibition last year, two pictures were shown giving a diameter to the moon of 1.38 metres.

"A TREATISE ON PHOTOGRAPHY." By Sir W. de W. Abney, K.C.B., D.C.L., F.R.S. Tenth edition. (Longmans.) Illustrated. 5s.—Sir William Abney's "Treatise on Photography" is so well known in its previous editions that attention need only be drawn to the additions that he has made in the present issue. He has very carefully and fully described the processes of photo-block printing where the details of the work are not yet kept secret by the firms who use this method, and chapters are also added on the orthochromatic and trichromatic processes. On page 277 there is an interesting little account of the author's experiments in pinhole photography. He points out (as Lord Rayleigh did some years ago) that there is a focus of best definition for each particular aperture of pinhole employed, and he also notes that after the aperture of the pinhole is diminished beyond a certain limit, the image ceases to improve in sharpness, as might be expected, owing to the serious diffraction that takes place. The aperture d in millimetres which he finds to correspond best with the distance f in metres of the hole from the plate, is given by the empirical formula $d = 1{\cdot}25\sqrt{f}$, but this does not take into account the wave-length of the ray of light as it theoretically should. Has Sir William ever tried the effect of coloured screens with a pinhole aperture?

"A CIVILIAN WAR HOSPITAL." By the Professional Staff: Drs. A. A. Bowley, H. H. Tooth, C. Wallace, J. E. Calverley, and Surgeon-Major Kilkelly. With numerous illustrations. (John Murray.) 12s. net.—From the point of view of military medicine and surgery, the unfortunate war in South Africa has been of great value; for it has afforded an opportunity of obtaining information with regard to the injuries caused by small-bore, high-velocity projectiles, and the causes of enteric diseases. In this volume we have an account of the work of the Portland Hospital, and of experience of wounds and sickness, with a description of the equipment, cost, and management of a civilian hospital in the time of war From the large amount of valuable material thus made available, a few points of general scientific interest may be selected. Remembering the established connection between mosquitoes and malaria, and how plague is probably spread by the bites of fleas which have lived on rats stricken with the disease, the observation that flies were always numerous in places where enteric fever prevailed is suggestive. There seems little doubt that flies were to a large extent responsible for the

spread of typhoid, though the exact nature of the connection between the insect and the disease has not been made out. We read, for instance, "Flies seem to have a special attraction to enteric fever patients. In a tent full of men, all apparently equally ill, one may almost pick out the enteric cases by the masses of flies that they attract." But this is probably only one means of spreading the disease, and so little is known upon the whole subject that no definite conclusions can be drawn which would permit a scheme of preventive measures to be defined. In the present state of knowledge, it seems to be almost impossible to combat hygienically the spread of enteric in any army under conditions similar to those prevailing in South Africa. Inoculation was tried as a means of prevention, and the results obtained were decidedly in favour of it; but the number of cases was too small to justify any general adoption of the method. Another matter to which one naturally turns is the use of Röntgen rays in locating bullets and determining the nature of injuries to bones. It is admitted that the usefulness of the Portland Hospital would have been impaired considerably if the Röntgen ray apparatus had not been taken out. Simple observation with the fluorescent screen did not prove of much use, but photographs were found of extreme service, and a number of them serve to illustrate the volume under notice. Before the war, little was known as to the effects of high-velocity projectiles on bones, but the Röntgen-ray photographs have enabled surgeons to speak with tolerable assurance on what was formerly mainly speculative. The surgical side of the war is, in fact, much more satisfactory to contemplate than the medical. Of the 303 surgical cases admitted into the Portland Hospital, only three died. Nearly all the wounds healed without suppuration, and there were no cases of erysipelas or other forms of blood-poisoning. On the medical side we have the fact that there were 29 deaths in 232 cases of enteric fever, and even this death rate was low in comparison with that of other hospitals. Had it not been for this scourge, the medical casualties of the campaign would have been comparatively insignificant. Let us hope that the materials for the study of the fever afforded by volumes such as the one before us will lead to the development of means for the prevention and cure of the disease.

"THE STORY OF FISH LIFE." By W. Pycraft. (Newnes.) Illustrated. 1s.—In this little work—a companion to "Bird Life"—the author endeavours to interest non-scientific readers in the structure, habits, and evolution of fishes; and, on the whole, we think he may be said to have been fairly successful in a by no means easy task. Commencing with the earliest known types of fishes, the reader is shown how there has been a gradual modification and advance towards the modern forms; special interest attaching to the account of the mode in which the fins of ordinary fishes have been derived from primitive expansions, or flanges, running the whole length of the body. The sentence (p. 10) "that the various kinds of mud with their peculiar fossils represent different periods of time of great duration," is, however, calculated to give the beginner a very erroneous impression as to the mineral constitution of rocks in general. Were we disposed to be severely critical we might also comment on the construction of many of the author's sentences; and we may add that some of the chapter-headings are not to our liking, while it is new to us to hear an article of diet spoken of as a "familiar little friend" (p. 187). Nevertheless, Mr. Pycraft has furnished the public with a very readable and interesting "booklet," although his efforts have scarcely been well backed up by his artist.

"THE PLAY OF MAN." By Prof. Karl Groos. Translated by Elizabeth L. Baldwin, with a preface by Prof. J. Mark Baldwin. (Heinemann.)—There is scarcely a page of this book without some facts, observations, or conclusions of interest to students of human activities. The book contains an organised account of games of all kinds, drawn from many sources, and arranged so as to exhibit their scientific significance. In a volume published about three years ago, the play of animals was analysed in a similar way, and the general conclusions arrived at in both books are the same. The view that play represents an overflow of energy is shown to be insufficient, and also the other physiological idea, namely, that play merely represents recreation for exhausted powers. As in the book on the play of animals the conclusion seems to be that instinct is the foundation of play. The exact position Prof. Groos takes may be understood from the following explanation. "Play is the agency employed to develop crude powers and prepare them for life's uses, and from our biological standpoint we can say from the moment when the intellectual development of a species becomes more useful in the struggle for life than the most perfect instinct, will natural selection favour those individuals in whom the less elaborated faculties have more chance of being worked out by practice under the protection of parents—that is to say, those individuals that play. Play depends, then, first of all on the elaboration of immature capacities to full equality with perfected instinct, and secondly on the evolution of hereditary qualities to a degree far transcending this, to a state of adaptability and versatility surpassing the most perfect instinct." The last part of the book contains a philosophical examination of play from the points of view of physiology, biology, psychology, æsthetics, sociology, and pedagogy; and the whole work may be described as an interesting history of play with an attempt to find a reason for play phenomena. The translation reads fluently and is an excellent piece of work.

"PRACTICAL HISTOLOGY." By J. N. Langley, M.A., D.SC., F.R.S. (Macmillan.) 6s.—Histology, or the study of the minute structure of tissues, is a large and difficult subject, and a book which facilitates the work of students by giving concise and precise directions for experiments and observations is sure of an appreciative public. The book under notice belongs to this class. The preparation and methods of examination described are well selected and practical; the directions are sufficient, and with reasonable care instructive results can be obtained. The student of biology is, in fact, lead by plain paths to distinguish the structure, nature and properties of the various tissues of the animal body. The first chapter is concerned with the microscope and its use, and is followed by chapters containing directions for simple observation on the blood and lymph. Instructions are then given for staining, mounting, and other processes connected with the preparation of sections, after which follow twenty-eight chapters each containing experiments and demonstrations on the differentiated and undifferentiated cells which are built up into the organs of the body. To the naturalist who delights in animate nature this resolution of body substance into its ultimate elements has little interest, but to the student of physiology it is essential; and it is to these students that the volume will prove of service.

BOOKS RECEIVED.

The Earth's Beginning. By Sir Robert Stawell Ball, LL.D., F.R.S. (Cassell.) Illustrated. 7s. 6d.

The Sacred Beetle: A Popular Treatise on Egyptian Scarabs in Art and History. By John Ward, F.S.A. (Murray.) Illustrated. 10s. 6d. net.

The Stars: A Study of the Universe. (Progressive Science Series.) By Simon Newcomb. (Murray.) 6s.

Text-book of Zoology. By G. P. Mudge, A.R.C.Sc. (LOND.), F.Z.S. (Arnold.) Illustrated. 7s. 6d.

Wales (The Story of the Nations). By Owen M. Edwards. (Unwin.) Illustrated. 5s.

Chess Player's Note Book. By Rhodes Marriott. (Manchester: Sherratt & Hughes.) 1s.

Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, 1901. (Griffin & Co.) 7s. 6d.

History and Chronology of the Myth-making Age. By J. F. Hewitt. (Parker & Co.) 15s. net.

Process Year-Book, 1901. Edited by W. Gamble. (Penrose.) 3s. 6d.

Moral Nerve and the Error of Literary Verdicts. By Furneaux Jordan, F.R.C.S. (Kegan Paul.) 3s. 6d. net.

Whitaker's Almanack, 1902. 2s. 6d. net.

British History made Interesting. By C. V. Hartley. (Simpkin.)

Origin of Species. By Charles Darwin. (Murray.) 1s net.

International Annual of Anthony's Photographic Bulletin, 1902. (Iliffe.) 2s. net.

Current Papers, No. 5 (Reprinted Proceedings of the Royal Society of New South Wales). By H. C. Russell, B.A., C.M.G., F.R.S.

Treatise on "Levity" in its Relation to "Gravity." By Jas. H. Shaw. (Scientific Press.) 6d.

Nautical Astronomy. By J. H. Colvin, B.A. (Spon.) 2s. 6d. net.

Origin of Species. By Charles Darwin. (Ward, Lock.) Illustrated. 2s.

Elements of Botany. By W. J. Browne, M.A. (LOND.), M.R.I.A. (John Heywood.) Illustrated. 2s. 6d.

Annual Report of the Board of Regents of the Smithsonian Institution for the Year ending June 30th, 1900. (Washington: Government Printing Office.)

Practical Radiography. By A. W. Isenthal, F.R.P.S., and H. Snowden Ward, F.R.P.S. (Dawbarn & Ward.) Illustrated. 6s. net.

Commercial Geography of Foreign Nations. By F. C. Boon, B.A. (LOND.). (Methuen.) 2s.

Geographical Teacher, October, 1901. (Geo. Philip & Son.) 1s net.

City and Guilds of London Institute. Report on the Work of the Examination Department for 1900-1. (Whittaker.) 9d. net.

Research in the Scottish Universities. By James Gordon Macgregor, D.SC., LL.D., F.R.S. (Edinburgh: James Thin.)

XUM

NOTES.

ASTRONOMICAL.—Several attempts have been made to ascertain the date of the original construction of Stonehenge from astronomical considerations, but hitherto the adopted data appear to have lacked the precision which is necessary in calculations depending upon the secular variation of the obliquity of the ecliptic. There is every indication that one use of the structure was to mark the direction of sunrise at the summer solstice, and it is evident that if this direction can be determined the departure from it of the present point of sunrise will furnish material for an estimation of the date. In a paper recently communicated to the Royal Society, Sir Norman Lockyer and Mr. F. C. Penrose give particulars of observations made last year which have led them to fix the date at about 1680 B.C. The adopted azimuth of the axis is 49° 34′ 18″, and the elevation of the local horizon 35′ 30″; it has further been supposed that the sun's upper limb was 2′ above the horizon when the observations were made, this estimate being based upon an actual observation of sunrise made on June 25th. It is notable that implements which have been discovered since the above observations were made also indicate a fairly accordant date.

The probability that the solar corona consists largely of particles capable of reflecting the light of the photosphere has been greatly strengthened by the observations of the eclipse of last May. The evidence of polarisation obtained by Mr. Newall has been fully confirmed by the work of the party from the Lick Observatory, and the Lick observers have also established the presence of Fraunhofer lines in the spectrum of the outer corona by using instruments of low dispersion. The continuous spectrum of the inner corona is readily accounted for by supposing the particles to be incandescent in the immediate neighbourhood of the photosphere. It therefore seems reasonable to suppose that the coronal streamers consist of finely-divided particles of matter ejected with great velocity from the surface of the sun. The observations of all the eclipses since 1893 indicate that the part of the corona giving a gaseous spectrum is relatively very shallow.

Further details given in Lick Observatory Bulletin No. 10 appear to leave little doubt as to the reality of the enormous proper motion of four condensations in the nebula surrounding Nova Persei. The result was arrived at by comparing a photograph taken on November 7th with one taken 48 days earlier at the Yerkes Observatory, from which it appears that the movement is at the rate of 11′ a year, and is certainly not radial. It is probable that the nebula is intimately connected with the Nova, and it does not seem unlikely that a study of their relationships will throw much light on the origin of new stars.—A. F.

BOTANICAL.—The function of crystals of calcium oxalate in plants is discussed in the current volume of the *Botanical Gazette* by Dr. A. Schneider. The commonly accepted theory is that these crystals protect the plant against herbivorous animals, either in consequence of an unpalatable taste which they are supposed to impart to the herbage, or of mechanical interference. It is shown that calcium oxalate is dissolved with difficulty, being insoluble in water, alcohol, ether, acetic acid, saliva, and other animal secretions, and is, in these substances, tasteless. It is therefore inferred that taste does not repel animals. Protection by mechanical means is thought to be improbable from the way in which the crystals are distributed through plant-tissues. Instead of being confined to peripheral parts, where their effects would be most pronounced, they are often abundant in the pith and heartwood of stems. Kraus in 1891 suggested that calcium oxalate was a reserve product, which would be re-dissolved and again utilised by the plant. This, Dr. Schneider believes, is its secondary function, the primary one being that of mechanical support as exemplified in parts of certain plants where sclerenchymatous tissue is replaced by crystal-bearing cells.

In the *Indian Forester* for October, 1901, Sir Dietrich Brandis draws attention to two Burmese aromatic woods, one of which (*Cordia fragrantissima*) is the source of a cosmetic and perfume used by Burmese ladies. It has a brown, very hard heartwood, which is strongly aromatic, differing in this respect from that of allied species, in one of which, however, it is slightly scented. The other wood is produced by a close ally of *Santalum album*, the sandal-wood tree, but differs in having longer medullary rays and a dark olive-brown heartwood.—S. A. S.

ZOOLOGICAL.—So far as mammals are concerned, the most important event we have to chronicle is the arrival at the Duke of Bedford's park, Woburn Abbey, of a drove of Przewalski's horse (*Equus przewalskii*), from the deserts of Mongolia. Although this species was described twenty years ago, no specimen has hitherto reached England, and naturalists have been very imperfectly acquainted with its affinities, and have had doubts whether it was really entitled to rank as a species. In spite of being colts, the specimens at Woburn Abbey demonstrate the distinctness of this most interesting member of the equine family, and show that it is more nearly related to the horse than to the wild asses, although presenting some resemblance to the latter. In general appearance the colts are not unlike New Forest ponies, although their white muzzles give them a somewhat asinine appearance. They are dun-coloured, with black points, and show in most cases no dark stripe down the back. They have, like the horse, "chestnuts" on all four legs; but the long hairs on the tail do not commence quite so high up as in that species.

Dr. A. Nehring, of Berlin, has recently described (in *Globus*) the skull of a large fossil camel from Russia, which he believes to be the ancestor of the living two-humped Bactrian species. These two species appear, indeed, to be natives of Central and Northern Asia, and are essentially adapted for a cold climate. The one-humped Arabian camel, on the other hand, seems to have originated in tropical or subtropical regions.

American naturalists are devoting much attention to the restoration of the external bodily form of extinct animals; and in the Smithsonian Report for 1900 Mr. F. A. Lucas, of the U. S. National Museum, has published an interesting paper dealing with the history of the subject. The attempts at restoration by Cuvier in Paris and Waterhouse Hawkins at the Crystal Palace,

together with others, are each in turn referred to. The author then describes in considerable detail modern American methods of arriving at an opinion as to what an extinct animal really looked like when in the flesh. "While the restoration of extinct animals," he observes, "is subject to some uncertainties, and mistakes of interpretation are likely to occur, these efforts to reproduce the living forms of past ages are not mere guess-work, but rest upon a solid foundation of scientific facts and careful deductions." One great difficulty is that the skeleton gives no clue to many external peculiarities. For instance, we could not tell from their bony framework that the African rhinoceroses have a smooth skin, while in the Asiatic species it is thrown into great folds. In some cases, therefore, it is almost certain that the restorations cannot be exactly true to nature. Nevertheless, the work deserves every encouragement, and cannot fail to add to the popular interest in extinct animals.

At a recent meeting of the Zoological Society, Mr. O. Thomas, of the British Museum, gave an account of the specimens of the "five-horned" giraffe brought home by Sir Harry Johnston from the neighbourhood of Mount Elgon, in the Uganda Protectorate. In spite of the unusually strong development of the horns, these specimens were referred to the typical North African giraffe, which appears to pass gradually into the giraffe of South Africa. The Somali giraffe, on the other hand, of which fine specimens were obtained by Lord Delamere during his expedition to North-eastern Africa, is a distinct species, which must be known as *Giraffa reticulata*. With regard to the two posterior rudimentary horns, to which attention was first directed by Sir Harry Johnston, it appears that these exist in all members of the group. They seem to correspond to the large pair of occipital horns which occur in the extinct genus *Bramatherium*, from Perim Island, Gulf of Cambay, and may therefore have been much larger in the giraffe's ancestors.

An important monograph on the structure of the skull in the egg-laying (monotreme) mammals, by Professor J. F. van Bemmelen, appears in the Denkschrift of the Jena Society, as one of the contributions to the results of Dr. Semon's recent expedition. The material thus obtained has very largely increased our knowledge of many peculiar types of Australasian animal life.

American naturalists are turning their attention with considerable energy to the animals of the Old World; Mr. G. S. Miller, in the *Proceedings* of the Biological Society of Washington, having recently described three new shrews from Asia and one from Switzerland.

TRAVELLING IN THE SUDAN.—We have received from Captain Stanley S. Flower, the Director of the Sudan Wild Animals Department, a copy of a pamphlet entitled "Notes for Travellers and Sportsmen in the Sudan." The pamphlet is published "by authority," and gives much well-arranged information, which will be found exceedingly useful to those intending to travel and shoot in the Sudan. We note, with pleasure, that the Game Laws have been lately revised, and that the number of animals and birds protected has been increased. It is now illegal to kill or capture the following animals and birds anywhere in the Sudan:—Chimpanzee, Eland, Giraffe, Rhinoceros, Zebra, Wild Ass, Ground Hornbill, Secretary Bird, and Shoe-bill; while in certain districts the Elephant and Hippopotamus are also protected. Many other animals and birds are protected by limiting the number which may be captured or shot. But perhaps the most valuable innovation is the creation of a large Game Reserve, in which only officers of the Egyptian Army and of the British detachment at Khartoum and officials of the Sudan Government have the privilege of shooting. This reserve will thus form practically a sanctuary.

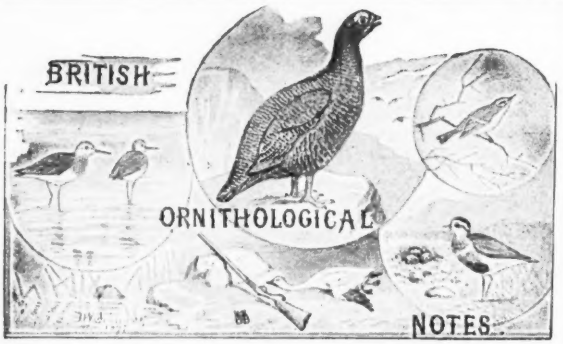
THE REV. H. A. MACPHERSON.

We much regret to have to record the death of the Rev. H. A. Macpherson, which took place at Pitlochry in November last. As a naturalist, and especially as an ornithologist, Mr. Macpherson was well known. He was a native of Skye, and was for some years chaplain of Carlisle Gaol; while in 1897 he was nominated to the perpetual curacy of Allonby, and was incumbent of the Episcopal Church of Pitlochry. During his residence in Cumberland he published a book in collaboration with Mr. Duckworth on the birds of that county, and an important volume on the Fauna of Lakeland. He was also the author of the "History of Fowling," while he contributed to the volumes on the "Grouse" and the "Partridge" in the Fur and Feather series, and was well known for his many articles and notes appearing from time to time in the *Ibis*, *Zoologist*, *Field*, and other journals. Beyond his literary abilities Mr. Macpherson was an excellent field-naturalist, and his loss will be keenly felt by all ornithologists.

DARWIN.

Mr. Horace Montford's new bust of Darwin, made for Mr. Andrew Carnegie.

A BUST OF DARWIN.—We are enabled to reproduce a photograph of one of the two busts of Darwin for which Mr. Montford, the sculptor of the Shrewsbury statue, has received a commission from Mr. Andrew Carnegie. The busts are cast in bronze and mounted on marble pedestals, and the work is based on the marble bust made by the same sculptor for the late Lord Farrer. One of the busts will be placed in the Pittsburg Museum, and the other will go to Skibo Castle.



Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

BAER'S POCHARD (*Nyroca baeri*) IN HERTFORDSHIRE.—At the meeting of the British Ornithologists' Club, held on November 20th, 1901, the Hon. N. Charles Rothschild exhibited a specimen of this Asiatic duck, which had been shot on the Tring Reservoirs, Hertfordshire, on November 5th, 1901. This duck had never before been obtained in the British Islands, and the only question was whether Mr. Rothschild's specimen was a truly wild bird or an escape. The specimen had no appearance of having been in captivity, and Mr. Rothschild had satisfied himself that it had not escaped from the Zoological Gardens, where there are four pinioned birds of this species. The Duke of Bedford and Mr. J. G. Millais, in reply to enquiries, stated that they were not aware of any of these birds having been turned out on artificial waters in this country. So that the evidence so far points to the fact that Mr. Rothschild's specimen is a truly wild bird, which doubtless lost its way and wandered to this country in the same way that other Asiatic birds have done, *e.g.*, MacQueen's Bustard and Radde's Bush Warbler.

CAROLINA CRAKE (*Porzana carolina*) IN TIREE.—At the same meeting as that referred to above, Mr. E. Lort Phillips exhibited a specimen of the American bird, the Carolina Crake, which he had shot in the island of Tiree, on October 25th, 1901. Two other specimens of this species have been recorded as having been obtained in Great Britain.

YELLOW-BILLED CUCKOO (*Coccyzus americanus*) IN SOMERSETSHIRE.—Another American bird, the Yellow-billed Cuckoo, which has occurred several times before in the British Isles, was exhibited by Mr. Robert H. Read. The specimen was obtained at Pylle, near Shepton Mallet, on October 6th, 1901, by Mr. F. Dowling. A discussion on these specimens resulted in the opinion that the birds which visited us from America, and especially insectivorous species such as the Cuckoo, were under the suspicion of having received assistance in crossing the Atlantic by resting upon ships. It had often been observed on Atlantic passages that birds alighted on the vessel near America and rested in the rigging until the ship neared the coast of Ireland, when they flew off to the shore. At the same time it was a fact that American birds almost invariably visited our shores in October during the autumnal migration, which pointed to the conclusion that they had been blown out of their normal course. With a bird such as the Crake, with a strong flight and powers of alighting and resting upon the water, it was possible to understand that it could accomplish the passage of the Atlantic unaided.

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, *at 10, St. Germans Place, Blackheath, Kent.*

STUDIES IN THE BRITISH FLORA.

By R. LLOYD PRAEGER, B.A.

I.—PLANT COLONISTS.

PRIOR to the time when man in these countries began to till the ground—say between 2000 and 5000 B.C.—the face of the land had an aspect very different from what it bears at present. Long before Neolithic man introduced the arts of husbandry, and began to choose pasturage for his flocks and to sow in the ground, in order that he might reap, the land had been completely colonised by plants which are still our common wild-flowers, and every nook and corner had its chosen inhabitants. On the lower grounds, forest trees held sway, and herds of grazing animals roamed through extensive woods. In rougher country great stretches were occupied by trees of lesser stature, and deer and wild boar and wolf found secure retreats among thickets of Oak, Birch, Holly, and Hawthorn, such as still occupy stony slopes in hilly districts. Elsewhere grassy downs extended, and great undrained marshes—secure home of the crane and bittern—while in mountain regions alone the scene was very similar to that which still meets the eye. The vegetation was that which entered or returned to the country at the close of the Glacial Epoch, and which has held sway, except when disturbed by man's operations, ever since. At what period, from what centres, by what means, and in what order our present flora arrived in the country, and what has been its history since its arrival, are questions of deep interest, on which recent researches in our latest geological deposits are casting light. To that subject we may return later; suffice it for our present purpose to find, at the period when man's influence first began to affect the vegetation, the bulk of our present flora firmly established in the country.

When our forefathers commenced to till the ground, a destruction of the native plant associations was the result; and this gave an opening for other plants suited to the new conditions. Annuals could maintain their hold year by year on the tilled land, where the former perennial plant-groups could no longer exist. And clearly those plants whose seeds happened to be mixed with the grain which the early husbandmen sowed, would have an excellent opportunity of survival. Thus we can conceive that the now large and well-marked group of weeds of cultivation had a very early origin. Nor is it impossible to conjecture that in some cases plants originally native may have found a congenial habitat on these prepared grounds, and by degrees forsaken their old haunts and established themselves mainly here, and become parasitic, so to speak, not on man, but on man's operations. Certain it is that we have plants in our flora, which are presumably original natives, yet are always or generally found in association with man (though not of any service to him) in cultivated land or about dwellings,* etc. Pot-herbs and simples were no doubt also of very early introduction, and, planted near the dwellings, in many cases established themselves. In the woodlands and thickets, the influence of man was probably more slow to make itself felt; but the lopping of branches and felling of trees of chosen sorts for the manufacture of utensils and implements, and for firewood, must have by degrees effected the plant associations of the forest; and in later times wholesale clearing of wooded areas for purposes of

*An illustration: What would be the distribution of the Wall Rue or Wall Pellitory if man did not use lime mortar for building?

husbandry banished the sylvan species, and allowed other plants to usurp the ground. And all the time, as trade and intercourse increased, circumstances favoured the introduction of fresh colonists. The growth of towns began to have a local effect on the flora; accumulations of rubbish of all kinds harboured a motley half-alien vegetation, and the fouling of rivers tended to break up the natural plant associations of the waters. The draining of marsh-lands completely altered the flora of large areas; the building of roads and the diverting of streams played their parts both in extermination and introduction. The gratifying of the æsthetic perceptions of the race also by degrees exercised a great influence on the flora, and with the advance of horticulture exotic after exotic escaped from the bounds of cultivation and more or less permanently won a place among the native vegetation. With the growth of modern commerce, and the construction of canals and of railroads, an immense impetus was given to the introduction and dissemination of all kinds of plants; till, in these last days, we deem it a matter of but momentary wonder to find, growing in company with native forms, some flower that has wandered hither from the shores of the Black Sea or the Baltic, from New Jersey or California.

From this brief history it will be seen that the vegetation of our islands, as it now presents itself, is by no means a homogeneous or natural assemblage of plants. The higher regions of the mountains, the large lakes, swamps, and bogs still retain their primitive facies, and there the original flora remains almost unmolested; but as we pass from these waste lands to the inhabited areas, where highly cultivated land is dotted over with towns and villages, and intersected with roads, railways, and canals, a greater and greater number of alien plants put in their appearance, till in waste ground adjoining harbours or mills, we may find a rank flora struggling for existence amid murk and dust, in which exotic plants, the produce of widely separated lands, form the larger portion of the vegetation. To take an instance, the flora of Ireland numbers about 900 undoubtedly native species, to which may be added about 130 others which, though now permanent members of the flora, are considered to be possibly or certainly introduced originally; and about 200 other plants have been found growing spontaneously, which are certainly exotic, and not established. In other words, of this total of 1230 plants, 73 per cent. represent the original vegetation of the country; 10 per cent. we may generally call plants which came with man and have now won a place in the permanent flora; while 17 per cent. represent the waifs and strays brought into the country by trade, agriculture, and horticulture; some of the last will no doubt eventually establish themselves.

We may now consider in greater detail the various groups of which our immigrant vegetation is composed, and dip, where it is possible, into the history of a few of their leading members. If I draw many of my examples from Ireland, it is because the recent publication of "Irish Topographical Botany" brings detailed statistical information concerning the flora up to a later date than is available for England.

First we have the group of crop plants—species which are grown for economic purposes, and which may spread and establish themselves. Some of these are, others may be, original natives; others again are undoubtedly exotic. The Lucerne (*Medicago sativa*), for instance, a native of the eastern Mediterranean, has long been grown as a fodder plant, and has now established itself on banks and dry ground in many places. The Comfrey (*Symphytum officinale*), on the other hand, is undoubtedly native in England, but apparently not so in Scotland or Ireland; yet has been so widely cultivated that its range now extends all over Ireland, and well up into Scotland. The Parsnep (*Pastinaca sativa*) in rank and distribution stands on a very similar footing; it has been in cultivation since Roman times. The Turnip, in its various forms (*Brassica Rapa, Napus campestris*) may be cited as one of the plants whose standing it is now almost impossible to determine. It has been widely cultivated for several thousand years, and is so still, whether as a root crop, for fodder, or for the manufacture of rape or colza oil. Which of the many forms are or were native, and what their distribution was, are questions which cannot now be answered with any degree of satisfaction.

From these crop-plants we turn to the next group—the many unwelcome species which accompany them in tilled ground, and which we call weeds. The typical weeds of cultivation are annual plants with small seeds, and they favour dry soils. Only annual plants (or species with deep-creeping underground stems like the Couch-grass) can maintain their position in tilled land, which each year undergoes a complete turning-over. Their numerous small hard seeds are well calculated to receive a wide scattering by wind or other agencies, to escape the eye of birds and other gleaners, and to endure the severities of the winter. Abundantly sown, they year by year bring forth abundantly. In a field of corn we see these plants at their best. The Poppies *may* be original natives, but we certainly never see their scarlet blossoms in such glorious display as among the corn. The Fumitories belong to the same category. The Corn-Salads are more open to suspicion, except *V. olitoria*, which may be seen far from cultivation; on the basaltic cliffs of Antrim, it forms a close mat in spring with the Mossy Saxifrage, mixed with several species of *Hieracia*. The White Mustard (*Brassica alba*), Wild Radish (*Raphanus Raphanistrum*), *Erysimum cheiranthoides*, the charming Blue-bottle (*Centaurea Cyanus*), the Corn-cockle (*Lychnis Githago*), are confined to cultivated ground, and we assume them to have been introduced with seed. Many of them can maintain themselves year by year if only tillage keep the ground clear of aggressive perennials; but others, like Gold-of-pleasure (*Camelina sativa*), *Saponaria Vaccaria*, *Silene dichotoma*, etc., though growing luxuriantly when sown with the crop, do not usually appear the following season; perhaps the dampness of our island-winters destroys the seed of these plants of the European continent. Of some of these weeds of cultivation, now abundant, we can approximately date the introduction. *Veronica Buxbaumii*, a plant with a wide distribution on the Eurasian continent, appeared in England about 1825, in Ireland prior to 1845; it is now one of the common weeds of cultivated ground from end to end of these islands. *Veronica peregrina* is an American plant, now widespread over Europe. It appeared in Ireland in 1836, and has colonised garden ground over a large area of the north-west of the island. Of the Lesser Broom-rape (*Orobanche minor*), we read in 1866 that it has been noticed in two clover-fields in Cork, for one season only, having been introduced with the seed; now it occurs over the whole east and south-east of Ireland, from Belfast to Bantry, and in the south-east is permanently established. So with the Clover Dodder (*Cuscuta Trifolii*) in Ireland. In 1866 it "has been observed once or twice in clover fields, but has not

become established; its seeds appear to be killed by a severe winter." It is now naturalised in widely separated stations, chiefly in sandy soil near the sea, and is advancing rapidly in some cases into wild ground. Both of the last-mentioned plants are widespread European species, and, as might be expected, they colonised England prior to their invasion of Ireland.

To an allied category belong those plants, not indigenous, which are of casual introduction. That they were not introduced with crops is shown by the fact that their headquarters are not in cultivated land, but in situations of different and various kinds, and often of an artificial character. Seeds of these species have come into the country by one means or other in the course of trade and commerce, and when they have happened to fall on suitable ground, they have formed a colony, and sometimes spread widely. The Lesser Toadflax (*Linaria minor*), a plant of sandy soils, is spread over almost

FIG. 1.—Present range of three Irish railway colonists.

Linaria minor, first observed about 1819.
Diplotaxis muralis, " " 1833.
Arenaria tenuifolia, " in 1897.

the whole of Europe, but is not considered native in the British Islands. In Ireland it was introduced early in the nineteenth century. Not finding there the sandy soils which it affects, it invaded the railways, and spreading along the gravelly ballast, has so increased that, excepting the northern counties, it now occurs all over the island. *Arenaria tenuifolia* has a similar history, except that it is native in England on light soils, and was not observed in Ireland till 1897; it is now known to occur, always on railway tracks, in fifteen out of the forty Irish county-divisions. Like the weeds of cultivation, both of these plants are annuals with numerous small seeds, which are easily transported. The most remarkable of recent Irish immigrants is *Matricaria discoidea*, a plant like a Chamomile without ray-florets, and possessing a strong agreeable Chamomile odour. It is a native of North America. First observed near Dublin in 1894, it is now spread, often in immense profusion, on railways, roadsides, and waste ground over the whole of central Ireland, embracing nearly half the country. This is also an annual, producing a great quantity of minute seeds.

The most famous of all our colonising exotics is the Water-Thyme, or Canadian Weed (*Elodea canadensis*), whose dramatic history is well known. Unintentionally introduced from America into Ireland about 1836, and England about 1841, it spread like wildfire through the rivers and canals, threatening to choke the water-ways, and carrying consternation to the hearts of the local authorities responsible for water-traffic and drainage. It has now paused in its wild career, and remains a perennial member of the flora over a great portion of the British Isles. Another American plant, and one whose status is far more difficult to determine, is the Rush, *Juncus tenuis*. During the last forty years this plant has been found in many European countries, and in these islands in Scotland, Wales, S.W. England, and West Ireland, chiefly on roadsides in uncultivated districts near the sea. If it is native, it is hard to credit its being so long undetected; if introduced, the difficulties of accounting for its wide distribution in wild regions, far from centres of dispersal, are equally staggering. It is, naturally, near the centre of trade that foreign immigrants most abound. About docks and railway sidings, flour mills and distilleries, and ballast heaps, we may gather, sometimes by the score, waifs from many parts of the world. Many of these are old acquaintances, loafers in half the seaports of the land; for instance, *Lepidium Draba*, *Erysimum orientale*, *Silene Armeria*; and various species of *Sisymbrium*, *Malva*, *Melilotus*, *Xanthium*, *Echinospermum*, *Bromus*, and so on, drawn from various parts of Europe and America, swell the motley crowd.

The cultivation of pot-herbs and simples, though now almost fallen into disuse, has bequeathed to us a varied and extensive legacy of plants of doubtful standing. The domestic use of many such species in these countries dates back to the Roman occupation, and in early Christian times the spread of monastic establishments distributed medicinal and culinary herbs all over the country, for the monks were skilled in leechcraft and gardening. As in other cases, it is now often difficult to determine in what instances the plants were derived from aboriginal stock, and in what cases they were imported and have since run wild. The great Leek, *Allium Babingtonii*, is widely distributed among native plants along the west coast of Ireland, and grows also in Dorset and Cornwall; yet there appears a strong probability that it is a relic of ancient cultivation. Several other Leeks, and many Mints, have the same story. The Good King Henry (*Chenopodium Bonus-Henricus*), Caraway (*Carum Carui*), and Parsley (*Petroselinum sativum*) are more evidently of cultivated origin, still haunting chiefly the vicinity or sites of dwellings. The noble Elecampane (*Inula Helenium*) was formerly in great repute as a pectoral and stomachic medicine, as witnessed by the old Latin adage—

Enula Campana reddit præcordia sana.

Its candied rootstock is still used as a sweetmeat. A few years ago I came across a colony of this plant which

is interesting as showing its early use, and the persistency of its growth. Inismacdara (*the island of the son of Dara*) is a small islet in the Atlantic off the Connemara coast, windswept and uninhabited, and known among archæologists as the site of a very early Christian settlement. Here, in the sixth or seventh century, Saint Sinach MacDara built a tiny oratory, of which the walls, formed of cyclopean masonry, and even portions of the solid stone roof, still remain. That the little colony had not a very long history appears from the fact that no trace of ecclesiastical edifices of later date exists; but that the ruins were respected, and that no house or garden at any subsequent time occupied the site, may be assumed from the reverence in which the memory of the saint, his church, and stone cross are still held—not to mention the remoteness and desolate inhospitableness of the place. Visiting the spot a few years ago, a colony of the Elecampane was observed hard by the church, where, no doubt, the saint had his modest kitchen-garden. Even allowing the establishment to have existed for three or four centuries, a clear thousand years is left during which this plant has maintained its existence. As instances of other cultivated medicinal herbs now widely distributed among the native flora may be mentioned the Horse Radish (*Cochlearia Armoracia*), Gout-weed (*Ægopodium Podagraria*), Alexanders (*Smyrnium Olusatrum*), Sweet Cicely (*Myrrhis odorata*), and Dwarf Elder or Dane's-blood (*Sambucus Ebulus*).

In the same section of the flora we may place a few non-indigenous fruit-trees, now widely spread—the Wild Plum (*Prunus domestica*), Bullace (*P. insititia*), and Dwarf Cherry (*P. Cerasus*); likewise many species of Willow. The Willows have long been planted by river sides, for the purpose of basket-making and as a protection to the banks, and as they are naturally riverside species, much difficulty now arises in discriminating between indigenous and introduced forms.

Lastly, a long list might be compiled of plants which have been introduced into our gardens, shrubberies or lawns for ornamental purposes, and have effected a more or less permanent lodgment beyond the bounds of cultivation. The Wall-flower (*Cheiranthus Cheiri*), Yellow Fumitory (*Corydalis lutea*), Red Valerian (*Centranthus ruber*), and several species of Stonecrop have escaped to walls and rocks, which they brighten with an abundance of brilliant blossoms; all are natives of Europe, but none of Britain. Among shrubs, several of the St. John's-worts, notably the large-flowered *H. calycinum*, a native of S.E. Europe, may be quoted as examples. A remarkable case is that of the Yellow Monkey-flower (*Mimulus guttatus*), a North American native, which has not only spread widely along river-sides, but shows a preference for invading quite wild ground, ascending the streams to their sources among the hills, and ousting the rank native vegetation of the swamps at the river-mouths. The Winter Heliotrope (*Petasites fragrans*), an Italian species, is a relentless invader, before whom most of our woodland plants are as powerless as the Britons before the armour-clad phalanx of Rome. With perennial creeping rootstock and dense foliage which chokes off every other plant, it advances steadily, entirely usurping the ground. And as the fleshiness of its underground stems ensures for it a prolonged vitality, it colonises every garden rubbish-heap in which a scrap of its stems occur. Thus it has attained a wide distribution—in Ireland it is recorded from 34 out of the 40 divisions. Steller's Wormwood (*Artemisia Stelleriana*), a native of distant Kamtschatka, cultivated in gardens on account of its pretty felty grey foliage, has spread to wild sand-dunes on the coasts of the United States, Sweden, and Ireland, among such purely natural surroundings that it has been claimed as a native by botanists of high repute.

Summing up all that has been said, we see how composite a thing our present-day flora is, and how many difficulties the student of geographical botany has to contend with in endeavouring to trace the history of the vegetation of the country. A weed may perhaps be defined as a flower in the wrong place; but in Nature there are no wrong places. Let tillage cease on any portion of the earth's surface, Nature takes it in hand; and through more or less rapid progressive changes of flora, the land is occupied by the plants best fitted to hold it, and the natural equilibrium restored. And while our beautiful aboriginal vegetation has for all scientific minds a surpassing interest, not less interesting is the strangely heterogeneous collection of plants that stand ranged about the works of man. The native flora speaks to us of pre-historic times, and links the present with the past; our "weeds," using the term in a wide sense, are full of human interest, and furnish indeed a floral history of mankind, telling us of his migrations, his early civilisation, his arts and crafts, and his trade-routes by land and sea.

COLLECTING AND PREPARING FORAMINIFERA.

By A. EARLAND.

THE Foraminifera, in spite of their beauty, the important part which they have played in the building up of our earth, and the many interesting features of their life-history, have not met with so much favour among microscopists as many groups of far less importance. This comparative neglect is largely due to mistaken ideas as to the difficulty of obtaining and preparing suitable material, and it is proposed to show, so far as possible within the limits of a brief paper, that the collection of material is within the reach of every visitor to the seaside, and that the subsequent preparation presents no unusual difficulty to the microscopist.

The chief sources from which Foraminifera may be obtained are:—

1.—Dredged material, including anchor muds and sands.
2.—Shore gatherings made between tide marks.
3.—Sands, clays and limestones of various geological ages, especially from Cretaceous and Tertiary deposits.

Probably very few readers of KNOWLEDGE will have the opportunity of dredging for material, and anchor muds, which often contain an abundance of shallow water forms, are rarely obtainable, owing to the strange reluctance of seamen to lend themselves to the collection of scientific material, but the method of preparation for materials of this class is essentially the same as that for shore gatherings.

The apparatus required by the shore collector is of the simplest character, and consists of a scraper for removing the surface film of sand, which alone contains Foraminifera, a spoon for scraping material from ripple marks and depressions, and a metal box or canvas bag to contain the gathering. The best scraper is a thin plate of celloidin, such as a "Frena" film, as the thinness and flexibility of this material enable the collector to make his scraping with less admixture of

sand than is possible with the glass or metal slip usually recommended for use.

Thus equipped, the collector sallies forth between the tides. Probably everyone has noticed when at the seaside the white lines which run along the sands, parallel with the retreating tide. A pocket lens shows that the white material consists of the minute shells of Foraminifera, of which some are of a lustrous white colour, due to the comparative abundance of the *Miliolidæ*—a family of common occurrence in shore gatherings, characterised by opaque shells of a milky white or "*Porcellanous*" texture, while others are more or less glassy and transparent. These "*Hyaline*" forms are much less noticeable to the naked eye. They are mixed in varying proportions with fragments of shell substance, *Ostracode* shells, cinders and the lighter *débris* of the shore, and their presence in these lines is due to the separating action of the water, which on a smaller scale we shall later on employ in the cleaning of our collected material. The rocking action of the wave on the extreme edge of the ebbing tide keeps these shells and fragments of light specific gravity in suspension until after the heavier sand grains have subsided, and so they are left behind in the ripple marks and depressions of the sand. Sometimes a local eddy of the tide, produced by the neighbourhood of a projecting rock, or of groynes and piers, causes the material to be gathered together in large quantities, which show as extensive white patches on the sand, and prove a real gold mine to the collector, who will then obtain more material in half an hour than he could gather in several days from the ripple marks.

The collector must not conclude that there are no Foraminifera present because there are no white patches to be seen, but remembering the way in which these patches are formed of the lighter *débris* of the shore, must look for Foraminifera wherever he observes that such *débris* has been deposited.

On every coast, at intervals of varying distance, there are spots which appear to be the foci of the local tides and currents, and here the material will be found in the greatest abundance. These points will soon be discovered and may be worked at every tide; but they vary continually with the set of the tide and wind, so that a spot which has proved rich may be quite bare the next year. Thus in October, 1896, I found Bognor—always a rich collecting ground—had its richest point to the west of the pier; while in September, 1901, there was very little material obtainable except at Felpham, two miles to the east, where the beach was thick with *débris*.

Having found the material the collection is quite an easy matter. With the celluloid scraper at an angle of about 60° the thin surface film of Foraminifera and *débris* is easily scraped into a heap and transferred to the box or bag. Great care must be exercised not to dig down into the sand, for nothing but a heavy bag will result from this, the Foraminifera being confined to the surface layer. The material thus collected may be either cleaned at once, or after being slowly dried—avoiding great heat—may be packed away in bottles for a more convenient period.

The apparatus required for the cleaning and preparation of the dried material is simple and inexpensive, and, if desired, much of it may be easily improvised. The most necessary articles are a photographic developing dish of china, quarter or half plate size, according to fancy, sieves of different sizes and materials according to the collector's pocket, a cylindrical glass jar with a lip and without any neck or constriction at the top, and a retort stand or tripod made of an iron ring rivetted on three legs.

The sieves can be made by any copper-smith, and it is very convenient to have a series of varying degrees of coarseness; but for the beginner two sieves of 40 and 120 meshes to the inch respectively will be sufficient. My own sieves are of copper, 4 inches high, 4 inches diameter at top, sloping to 3 inches diameter at the bottom. A smaller size made of telescope tubing $1\frac{1}{2}$ inches in diameter and 1 inch deep is very useful for washing small gatherings. Zinc, which is cheaper than copper, can be used for the sieves.

The wire gauze, which can be obtained from any large ironmonger, varies in price according to the number of meshes to the inch, ranging from a few pence per square foot to four shillings for the finest obtainable, which has 120 meshes to the inch, the diameter of each aperture being about $\frac{1}{200}$ inch. If a finer sieve than this is required, as it sometimes may be, the size of the aperture may be reduced by silver-plating the gauze, or preferably by the use of silk bolting cloth, which may be obtained up to 200 meshes to the inch. The wire gauze must be strained tightly over the sieve and soldered neatly to the edge, so that there is no ledge of solder inside to retain unwashed material. If silk is used, a sieve must be made without a bottom and having a turned-back edge at the lower end, so that the silk may be strained across and secured with string or a rubber band. The most useful sizes for a series of sieves are, in my opinion, 12, 20, 40, 80, 120 and 150 (silk) meshes to the inch.

Before cleaning the material it must be slowly and thoroughly dried. It should then be passed through the 12-mesh sieve to remove all the coarse *débris*, stones, shells, cinders, etc. None of the British shore species except parasitic forms will be found in this coarse residuum, but it should be looked over with a pocket lens for these or for abnormally large specimens. In some dredged materials and in tropical gatherings, however, this coarse residuum will be found to be full of Foraminifera.

The material which has passed through the 12-mesh sieve consists of Foraminifera mixed with other light *débris* and a considerable quantity of sand, and the collector must now proceed to eliminate the whole, or nearly the whole, of the sand and as much as possible of the other *débris* by means of two operations, "floating" and "rocking." If the quantity of material to be operated upon is small, it may be treated off-hand, but if there is much, it is well to sift it out into varying degrees of fineness, by passing it through a series of sieves. This will simplify the floating operations by ensuring that the particles are approximately of similar weight.

The floating operations must be performed at a sink, and, if possible, in daylight, the process being more uncertain by artificial light. The finest sieve (120 wire or 150 silk) is thoroughly wetted and rested on the tripod. The glass jar is then filled with water nearly to the brim, and a few spoonfuls of sand slowly poured into it. If the material is coarse the sand sinks instantly, and in the course of a few seconds most of the Foraminifera follow suit. By holding the jar to the light the course of the falling particles can be followed, and at the proper moment a sudden tilt empties the whole of the water and most of the Foraminifera into the sieve, the sand and a few of the heaviest "Forams" being left in the jar. The purity of the material in the sieve, which is usually called "floatings," will depend upon

the skill and judgment of the operator, and is largely a matter of practice. The residuum in the jar must be washed out into a basin for further treatment, and the operation repeated with more sand and water until the whole of the gathering has been treated. The time allowed for subsidence will vary with the fineness of the sand, so that in the case of the finest siftings, nearly a minute may be required. The actual time can only be determined by watching the falling material in a strong light.

In the case of very fine sand the tension of the surface film of water is so great that the sand grains float almost as readily as the Foraminifera. This difficulty may be overcome by shaking up the contents of the jar, covering up the top with one's hand while so doing.

(*To be continued.*)

(See Note headed "Practical" below.)

Condueted by M. I. Cross.

RETROSPECTIVE.—The year 1901 did not witness any startling development in connection with the microscope, but it was one in which a steady progress was shown in nearly every department.

It witnessed the introduction of several new stands principally for students' use, two-speed fine adjustment devices, the increase in number and variety, and, above all, in the aplanatism of substage condensers and the substitution of actual working data for approximation in the case of tube lengths and cones of illumination.

In processes there were many new formulæ recorded, and judging from the number of articles which appeared on the subject, the science of micro-metallurgy is rapidly advancing. In the domain of preventive medicine, the best points of the microscope are becoming more fully appreciated and worked to greater advantage, and results are becoming increasingly reliable.

In literature the fresh edition of Carpenter on the Microscope was a feature of importance, and the paper read by Mr. J. W. Gordon before the Royal Microscopical Society in controversion of the Abbe theory of microscopic vision is still fresh in the memory.

On the whole, microscopists can congratulate themselves on the work done in the past year.

CO-OPERATION.—So much of the progress in microscopy in recent years has been attributable to the work of a few individuals that it has almost been lost sight of that the rank and file can and should do their share.

It is eminently desirable that a column of this kind should be made the medium for conveying the thought, research and observation of microscopists generally. The subject is so many-sided that it is impossible for any one individual to present it in its various aspects, and it is for those who catch glimpses and side lights that others do not notice, to add interest and increase knowledge by communicating their observations. There is scarcely a microscopist possessing enthusiasm, or who works thoughtfully, who has not found some little device of his own designing useful to him, or some process which has enabled him to produce more satisfactory results than by stereotyped means. Readers of these notes would always appreciate a short description of such methods, and by the communication of such ideas increased perfection would be attained.

PRACTICAL.—If microscopists generally can but be induced to become practical workers, that is, to prepare and mount their own slides, an increased interest and wider knowledge would be the result. The difficulty invariably is that suitable material cannot be procured; as an instance of this, I may mention that in the April number I offered to send a correspondent a small supply of Polcystina, and later mentioned that a supply was at the disposal of others. The applications that I received for samples indicated that there are numerous readers willing and anxious to mount their own specimens. Yet another instance; I have a letter from a correspondent, from which the following is an extract:—

"I hoped during the past summer to have been able to collect some specimens of Mycetozoa, but have not found one. What I want to suggest is that those collectors of such fungi who live in districts where they are found abundantly, should distribute their findings to those who are not so fortunate, by way of exchange, or for my own part I would willingly reimburse any expense in sending, as I should much value even a small collection. There must be many who have neither time nor opportunity of collecting who would gladly avail themselves of such an arrangement."

With these facts in view, it is proposed during the next few months, as far as possible, to offer material for readers to mount themselves and to give lucid instructions for doing the work.

In this number Mr. A. Earland contributes the first portion of an article on "Collecting and Preparing Foraminifera," and with the February number we shall hope to offer gratis to readers a supply of different kinds of material so that each may for himself practise the methods set forth.

I shall be very glad to hear from readers who are willing to help in this scheme, and who may be able to contribute notes from their own store of experience, or material for distribution.

I am glad also to be able to say that the experimental offer made in the last number to send a substage condenser for examination has received appreciation, and that manufacturers have arranged to co-operate so that the offer may be renewed on future occasions when other apparatus is reviewed.

NOTES AND QUERIES.

Rev. A. H. M.—It is certainly advisable to use colour sensitive plates for photo-micrography. I cannot recommend any special brand, but you would find Cadet Spectrum, Ilford Chromatic or Edward's Isochromatic quite satisfactory. Colour filters are also of very great importance, but you could readily learn their value from any work on photo-micrography. The photograph you send is a very good one of starch granules, especially considering it is the first attempt. You will find it necessary with a view to getting true images to use a larger aperture than you have in this instance, your condenser was evidently very much stopped down.

E. A.—No ordinary gas lamp is really satisfactory for critical micro work; still a very useful and simple pattern is employed in laboratories, and can be obtained for a nominal sum. It consists essentially of an upright rod attached to a round base, upon this rod a horizontal supporting bracket slides vertically and is fixed by a clamp screw. The horizontal arm carries an Argand burner and a chimney. I believe this can be obtained from Mr. A. H. Beard, of Lothian Street, Edinburgh, with a blue chimney. I know of no suitable acetylene lamp. Alternatively, the Welsbach mantle and burner can be used, of which you will obtain particulars from the Microscopical Notes in the May, 1901, number of KNOWLEDGE.

H. J. H.—The only maker I can trace who supplies an objective adjustable from 2″—4″ is W. Wray, of Laurel House, Highgate. I think you would get what you required from him.

G. W. B.—From the description you give you could not do better than have one of the Cathcart's pattern Microtomes; the difficulty you experience with the small hand section cutter would be satisfactorily overcome with this.

Reader of "Knowledge."—I am sorry to say I cannot identify the specimen you send, nor can I trace in any book the name of "Paludicella." I am not aware of any book being published dealing with Growths in Water-pipes.

Acarina.—The state of things that you describe in connection with your furniture is very disagreeable, but no serious consequence is to be apprehended so far as the wood work is concerned, from the acarus you have sent. This is the Book or Museum Mite—*Cheyletus eruditus*. I should be disposed to think that these live and multiply in the upholstering of the furniture. Shreds of sea-weed have been known to be substi-

tuted for hair in the stuffing of chairs, etc., and such material would form a good breeding ground for creatures of this description. They require a certain amount of dampness to propagate.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office, 326, High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

PERIODICAL COMETS DUE IN 1902.—The returns of two comets of short period may be expected during the year. Swift's comet of 1895 which was computed to have a period of 7¼ years is due in the autumn, but the conditions will be less favourable than in 1895, and it is probable that this object will escape redetection. Tempel-Swift's comet will return to perihelion in November, and is likely to be successfully observed as in 1869, 1880, and 1891. Its period is as nearly as possible 5½ years, and the circumstances favour its visibility at every alternate return occurring at intervals of 11 years. In 1869 perihelion occurred on November 18, in 1880 on November 8, and in 1891 on November 14. On these occasions its apparent path in the heavens was nearly the same, and the comet will run a nearly similar course during the autumn and winter of 1902.

SWIFT'S COMET, 1899, I.—Definite orbit-elements have been computed by Mr. C. J. Merfield, of Sydney (*Ast. Nach.* 3747-8). The comet was first seen on March 3, 1899, and 605 observations for position were obtained between March 4 and August 10. The following are the elements deduced:—

T = 1899, April 12, ·978010 G. M. T.
ω = 8° 41′ 46·48″
Ω = 24° 59′ 59·93″ } 1900.
i = 146° 15′ 30·29″
log. q = 9·5139795.
log. e = 0·0001521.
e = 1·0003503.

PERRINE'S COMET, 1897, I.—The orbit of this object has been investigated by Dr. J. Möller, who finds from observations between November 2, 1896, and April 29, 1897, that its path was decidedly hyperbolic. There appears, indeed, to have been only one other comet, observed in 1889, which exhibits this exceptional form of orbit in a more striking manner.

THE LEONID SHOWER OF 1901.—The nights of November 14 and 15 were generally clear in this country, though fog prevailed in some places. The meteors were attentively watched for, but only a moderate number seen. At short intervals a Leonid would shoot swiftly from the direction of "the Sickle," but nothing in the form of a brilliant shower was witnessed. At certain distant places observers appear to have been more successful according to some telegraphic reports published in the newspapers. Quite an active exhibition of Leonids was in fact recorded at a number of stations. The information comes from New York that on the early morning of November 15 a great shower was witnessed on board a steamer from New Orleans. On the morning of November 15 at the Leander-McCormick observatory of the University of Virginia, Va., Mr. C. P. Oliver, watching the sky from 4h. 50m. a.m. to daylight, saw 84 Leonids, the average being one per minute in spite of adverse atmospheric conditions. On the morning of November 16 at Phœnix, Ariz., a meteoric shower of great brilliancy was noted. It continued for half an hour during which it supplied 200 meteors. Just before daylight on November 16, at Los Angelos, Cal., the fall of Leonids was quite marked. One observer counted 385 meteors between 4 and 5 a.m., but the total number seen was estimated at over a thousand. From these and other reports it appears certain that the recent display was much richer than in 1899 or 1901, and the inference is that the tail end of the stream has not been disturbed to the same extent as the denser region. This leads to the hope that many Leonids will be visible in November, 1902, but unfortunately there will be a full moon to mar the spectacle.

FIREBALL OF NOVEMBER 10, 6H. 45M.—Scottish observers have supplied descriptions of a very brilliant meteor. At Crieff it was seen in the south-east "descending rapidly, and bursting into a number of rocket-like stars." At Aberdeen one observer says it flashed across the S.W. sky and lit up the earth like a search-light. Another observer there says that it was half the apparent diameter of the moon, and so bright as to be quite dazzling, and almost like a new sun. It crossed the sky from the region of α Pegasi to Altair. At Newtonhill it is described as crossing the heavens from E. to W., at about 40 degrees above the horizon, and making an angle of 20 degrees with it. In colour it appeared like a quantity of burning magnesium, and for the space of three seconds the country seemed as though lit by numbers of arc lamps. At Blairgowrie it emitted an intensely bright white light, and at Ellon, N.B., it was seen to burst out in Pegasus, and to travel in a direction to the S.W. From these and other accounts it appears that the meteor was a fine Taurid falling from a height of 64 to 55 miles from over the North Sea to Dunning, Perth. Length of path 73 miles, and velocity about 24 miles per second.

FIREBALL OF NOVEMBER 13, 6H. 53M.—Another magnificent meteor was seen in Scotland at this time, but only three descriptions have come to hand. Mr. A. C. Allen, of Keswick, says it passed to the right of α Cephei and δ Cygni, and to the left of γ Lyrae, and continued its flight some distance further. The meteor left a nebulous cloud near γ Lyrae for about 1½ minute, moving slowly to S.W., and curving into a crescent shape. The nucleus was accompanied throughout its course by a halo of about 45 degrees diameter. At Stair the meteor was estimated to have a breadth half the diameter of the full moon, and it broke into two pieces. It fell at any angle of 45 degrees from S.E. to S.W., and lit up the sky like a flash of lightning. "It only lasted 4 or 5 seconds." At Fife the meteor was exceedingly bright, of a greenish white colour, and it left a luminous streak for 4 or 5 seconds. It passed from about the centre of the square of Pegasus to α and β Capricorni. The radiant point was in Auriga probably at 87° + 34°, and the height of the meteor was from about 90 to 52 miles from over the Cheviot Hills 12 miles E. of Langholm to the Irish Sea in longitude 5° 47′ W., and latitude 53° 38′ N. Path about 165 miles and velocity about 33 miles per second.

THE FACE OF THE SKY FOR JANUARY.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the sun rises at 8.8 A.M., and sets 3.59 P.M.; on the 31st he rises at 7.43 A.M., and sets at 4.44 P.M. The earth is at its least distance from the sun at 7 A.M. on the 1st; the apparent diameter of the sun then being at its maximum, 32′ 35″·16; the horizontal parallax is then 8″·95, also a maximum.

Few sunspots are to be expected.

THE MOON:—

	Phases.	h.	m.	
Jan. 1	☾ Last quarter	4	8	P.M.
„ 9	● New Moon	9	15	P.M.
„ 16	☽ First quarter	6	38	A.M.
„ 23	○ Full Moon	0	6	A.M.
„ 31	☾ Last quarter	1	9	P.M.

The more interesting occultations visible at Greenwich are as indicated in the following table:—

Date.	Name.	Magnitude.	Disappearance.			Reappearance.			Moon's Age.
			Mean Time.	Angle from N. Point.	Angle from Vertex.	Mean Time.	Angle from N. Point.	Angle from Vertex.	
				°	°		°	°	d. h.
Jan. 12	c^1 Capricorni	5·2	4 17 P.M.	73	53	5 27 P.M.	238	209	2 19
„ 13	κ Aquarii	5·5	6 23 P.M.	10	340	7 1 P.M.	301	267	3 21
„ 21	71 Orionis	5·1	8 15 P.M.	22	50	8 39 P.M.	343	6	11 23
„ 24	κ Cancri	5·0	6 7 P.M.	110	147	7 1 P.M.	276	315	14 21

THE PLANETS.—Mercury is not well situated for observation, being in superior conjunction with the sun on the 1st; towards the end of the month it will be an evening star setting a little more than an hour after the sun, but even then it is too far south for easy observation.

Venus remains an evening star and attains her *greatest brilliancy* on the 9th, the apparent diameter then being 40″. Throughout the month she will form a conspicuous object in the south-west shortly after sunset, and with the exception of the last few days the

planet sets three hours in the rear of the sun, but has a more northerly declination of about 10°. The planet is at the stationary point on the 22nd, after which date her motion will be retrograde or westerly.

Mars is not well placed for observation, setting a little more than an hour after the sun. Towards the end of the month the planet will appear in proximity to Mercury, the two planets being in conjunction with each other on the 23rd; Mercury being 25′ to the south.

Jupiter and Saturn are invisible, both being in conjunction with the sun during the month, the latter on the 9th, the former on the 15th.

Uranus is only visible shortly before sunrise, and being very low is not suitable for observation.

Neptune continues to be favourably situated during this month. He crosses the meridian at 11.13 P.M. on the 1st, and at 9.2 P.M. on the 31st. The planet is in the most westerly part of Gemini, but its retrograde motion brings it into Taurus at the close of the month. The nearest bright stars are still η and 1 Geminorum, a continuation of the table given last month will enable it to be picked up readily when the telescope has been pointed to the two stars named above.

Date.	Neptune.		η Geminorum. Mag. 3·2–4·2.		1 Geminorum. Mag. 4·3.	
	R.A. h. m. s.	Dec. ° ′	R.A. h. m. s.	Dec. ° ′	R.A. h. m. s.	Dec. ° ′
Jan. 9	5 58 10	N. 22 15	6 9 0	N. 22 32	5 58 12	N. 23 16
„ 18	5 57 11	22 16				
„ 27	5 56 18	22 16				

On the night of the 9th the planet has the same right ascension as 1 Geminorum, the telescope will therefore only need depressing 1° to bring the planet into the field of view.

THE STARS.—The positions of the principal constellations and stars about 9 P.M. at the middle of the month are as follows:—

ZENITH . Perseus, Auriga (*Capella*).

SOUTH . Orion, Taurus, Pleiades, with Aries and Cetus towards the south-west, and *Procyon* and *Sirius* towards the south-east.

EAST . . Leo (*Regulus*) and Cancer low down, whilst Gemini (*Castor* and *Pollux*) is high up.

WEST . . Pegasus, Andromeda, Pisces, with Cygnus in north-west.

NORTH . Ursa Minor and Draco below *Polaris*, with Cassiopeia to the left, and Ursa Major to the right.

Minima of Algol occur at convenient times on the 5th at 11.29 P.M., on the 8th at 8.18 P.M., on the 28th at 10.1 P.M. and on the 31st at 6.49 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of December Problems.

(C. D. Locock.)

No. 1.

Key-move.—1. B to B2.

If 1. . . . K to Q4, 2. R to B5ch, etc.
1. . . . Kt to B2, 2. B to K4, etc.
1. . . . Kt to Kt3ch, 2. Kt × Kt, etc.

No. 2.

Key-move.—1. Kt to B2.

If 1. . . . P to R7, 2. R to R4ch, etc.
1. . . . P to Kt5, 2. Kt × RP, etc.

[Not 2. R × QKtP as given by two or three solvers.]

1. . . . K to R3, 2. R to R4ch, etc.

[A second solution by Kt to R6 was intentionally left, in the hope that it would limit the number of "ties" in the solution tourney. The expectation has been realised, the play in the second solution having sufficient merit to cause it to be mistaken for the author's intention. As a matter of fact, considerably more solvers have sent Kt to R6 than Kt to B2. The "cook" could presumably have been stopped by the addition of a White Pawn at QR6 and a Black Pawn at QR2.]

CORRECT SOLUTIONS of both problems received from J. Baddeley (6), H. Le Jeune (6), G. Groom (5), F. J. Lea (5), S. G. Luckock (6), W. de P. Crousaz (6), C. C. Massey (5), G. W. (6), Alpha (6), G. W. Middleton (7), W. Nash (6), W. H. Boyes (6), C. Johnston (7), A. C. Challenger (6), W. Jay (7), Major Nangle (6), Vivien H. Macmeikan (6), F. Dennis (6), J. E. Broadbent (7).

Of No. 2 only, from G. A. Forde, Capt. (3), W. H. S. M. (3), A. E. Whitehouse (3), W. V. M. Popham (3).

G. Groom.—Kt to R2 will not solve No. 2.

W. V. M. Popham.—Your solution to No. 1 (November) was received too late to acknowledge. In No. 1 (December), 1. B to Kt3 is met only by 1. . . . K to Q4, and if then 2. Kt to Q2ch, K × Kt.

W. H. S. M.—K to Q8 would be all right but for 1. . . . K to Q4.

W. de P. Crousaz.—I regret to find that you were previously credited with one point too much.

J. Baddeley.—KNOWLEDGE appears to have reached you two or three days late.

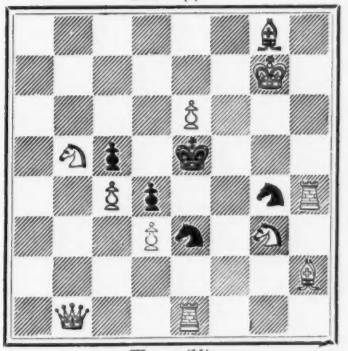
A. E. Whitehouse.—Please see answer to *W. V. M. P.* Very glad that you and others have continued to the end in spite of adversity.

PROBLEMS.

No. 1.

By S. G. Luckock.

BLACK (5).



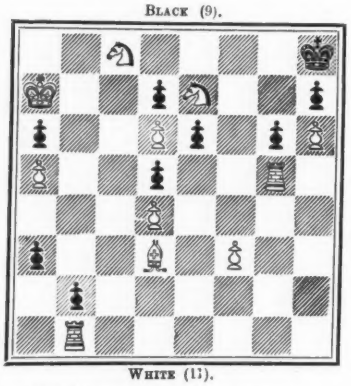
WHITE (11).

White mates in two moves.

No. 2.

By C. D. Locock and J. K. Macmeikan.

BLACK (9).



WHITE (11).

White mates in four moves.

After a close and exciting contest, the Solution Tournament, which has been in progress since last January, has come to an end. Last month's problems had the effect of reducing the number of ties to a minimum, the result being that Messrs. W. Jay and C. Johnston tie for the first and second prizes, while Messrs. A. C. Challenger and G. W. Middleton obtain the equal third and fourth prizes. While congratulating these expert solvers on their well-deserved success, we must also condole with Mr. Challenger on losing his chance of the first prize at the last moment, the same applying to Messrs Dennis, Groom, Luckock, and W. H. S. M., in regard to the other prizes. We have also to thank the many solvers who, after losing points at an early stage, continued to do their best, and have in many cases achieved prominent places.

The following is the order of the first sixteen :—

1. { W. Jay, 68 / C. Johnston, 68 } tie for first and second prizes.
3. { A. C. Challenger, 67 / G. W. Middleton, 67 } equal third and fourth prizes.
5. { F. Dennis, 66. / S. G. Luckock, 66.
7. { J. Baddeley, 65. / G. Groom, 65.
9. { J. E. Broadbent, 64. / G. W., 64.
11. { H. Le Jeune, 63. / W. H. S. M., 63. / W. Nash, 63.
14. Vivien H. Macmeikan, 62.
15. W. de P. Crousaz, 61.
16. C. C. Massey, 59.

We hope that all the above, and many others, will compete in the Solution Tourney which commences in the May number, and will continue to the end of the year.

An attempt will be made to decide the tie for first and second places by means of the four-move problem printed above, and the three-move problem sent by post to Messrs. Jay and Johnston. The conditions for both problems will be the same, viz.:—*Every correct key*, 3 points, 2 points being deducted for every incorrect claim. In the event of further equality, it is suggested that the prizes should be divided. The award will remain open for one month. Meanwhile, perhaps Messrs. Challenger and Middleton will let us know at what date they would prefer their six numbers of KNOWLEDGE to commence.

THREE-MOVE PROBLEM TOURNEY.

1st Prize, One-and-a-Half Guineas; 2nd Prize, Fifteen Shillings; 3rd Prize, "Knowledge," free for 12 months.

The Conditions are as follows :—

1. Each competitor may send not more than one three-move unconditional direct-mate problem (diagrammed).
2. Competing positions must be original and unpublished.
3. Each problem must be accompanied by a motto and full solution with a sealed envelope containing the composer's name and address.
4. Competing positions must reach Mr. C. D. Locock, Netherfield, Camberley, England, on or before April 10th, 1902.
5. The Chess Editor reserves the right of excluding manifestly impossible, unsound, or inferior positions.
6. The adjudication will be partly by solvers and partly by the Chess Editor.

All solvers who solve correctly every problem will be entitled to vote on their merits. The six or eight problems thus selected will then be adjudicated on by the Chess Editor, whose decision will be final.

A SOLUTION TOURNEY will commence at the same time. Full particulars will be given next month; in the meantime it may be stated that the winner will hold for 12 months a Silver Challenge Trophy, which will become his property should he win it three years in succession, or four years altogether. Second and Third Prizes will also be given.

CHESS INTELLIGENCE.

A Devon and Cornwall Chess Tournament is announced to take place at Plymouth during the second week in January. Entries, with entrance fee, 10s. 6d., should be sent to the Chess-Editor, *Western Morning News*, on or before December 28.

It is with the greatest regret that we have to announce the death of the Rev. John Owen, for forty years Vicar of Hooton, Cheshire. Mr. Owen was a member of the St. George's and Liverpool Chess Clubs, and, more recently, of the British Chess Club. For something like half-a-century he was one of the very strongest players in England, and to the end he never lost his skill. Mr. Owen was a frequent competitor in the meetings of the Counties' Chess Association, and took part in the International Tournaments held at Bradford in 1888, and Manchester in 1890. But in spite of his numerous successes Mr. Owen will perhaps chiefly be remembered for the match which, playing under the name of "Alter," he lost, receiving the odds of Pawn and move, to Paul Morphy in 1858. Mr. Owen invariably played the "close game," both as first and second player, his speciality being the Queen's Fianchetto defence. He delighted in crowded positions, and yet his games were seldom dull, few players being more brilliant when the opportunity arose.

All manuscripts should be addressed to the Editors of KNOWLEDGE, 326, High Holborn, London; they should be easily legible or typewritten. All diagrams or drawings intended for reproduction, should be made in a good black medium on white card. While happy to consider unsolicited contributions, which should be accompanied by a stamped and addressed envelope, the Editors cannot be responsible for the loss of any MS. submitted, or for delay in its return, although every care will be taken of those sent.

Communications for the Editors and Books for Review should be addressed Editors, KNOWLEDGE, 326, High Holborn, London.

For Contents of the Two last Numbers of "Knowledge," see Advertisement pages.

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